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AUTHOR Edwards, Peter; Ellis, E. N.  
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## ABSTRACT

The study was requested by the Vancouver School Board Reading Centre (VSBRC) and the Education Department of the Vancouver School Board. The main purpose of the study was to make pre-treatment and post-treatment assessments of pupils of the VSBRC so that an evaluation of the VSBRC program could be made. A Questionnaire was sent to the current teachers of the pupils concerned and also to the staff of the VSBRC. Teacher assessments of the pupils' academic skills and behavioural characteristics (both pre-treatment and post-treatment) were collected and analyzed. Results obtained showed that the pupils had improved in the following basic skills related to reading: visual perception, auditory perception, and phonic abilities. Considerable improvement was noted in both oral reading and recall, and silent reading and recall. The students also showed gains in arithmetic skills. Little change was evident in word analysis/vocabulary, while listening comprehension showed a decline. A number of marked, positive behavioural changes were evident in the areas of personal adjustment, social adjustment, effort and motivation. Several recommendations concerning the VSBRC program were made as a result of the study. Further studies of this nature, using more standardized measuring instruments and a control group of students who had a program of instruction from the VSBRC, were suggested for the future. (Author)

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A STUDY OF THE EFFECTIVENESS OF THE VANCOUVER SCHOOL  
BOARD READING CENTRE PROGRAM

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Peter Edwards

and

E. N. Ellis

Research Report 73-10

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## ABSTRACT

The study was requested by the Vancouver School Board Reading Centre (VSBRC) and the Education Department of the Vancouver School Board. The main purpose of the study was to make pre-treatment and post-treatment assessments of pupils of the VSBRC so that an evaluation of the VSBRC program could be made.

A questionnaire was sent to the current teachers of the pupils concerned and also to the staff of the VSBRC. Teacher assessments of the pupils' academic skills and behavioural characteristics (both pre-treatment and post-treatment) were collected and analyzed.

Results obtained showed that the pupils had improved in the following basic skills related to reading: visual perception, auditory perception, and phonic abilities. Considerable improvement was noted in both oral reading and recall, and silent reading and recall. The students also showed gains in arithmetic skills. Little change was evident in word analysis/vocabulary, while listening comprehension showed a decline.

A number of marked, positive behavioural changes were evident in the areas of personal adjustment, social adjustment, effort and motivation.

Several recommendations concerning the VSBRC program were made as a result of the study. Further studies of this nature, using more standardized measuring instruments and a control group of students who had not had a program of instruction from the VSBRC, were suggested for the future.

# A STUDY OF THE EFFECTIVENESS OF THE VANCOUVER SCHOOL BOARD READING CENTRE PROGRAM

## I. INTRODUCTION

### Background

The Vancouver School Board Reading Centre (VSBRC) was inaugurated in the fall of 1965. The Reading Centre was housed in the remodelled gymnasium situated on the grounds of the Emily Carr Elementary School. Mr. John H. Sutherland, who had been appointed Reading Coordinator for the Vancouver School District in September 1964, was placed in charge of the Centre.

The VSBRC was primarily designed to serve three main functions:

1. As a centre where severely retarded readers could receive special assistance,
2. As a demonstration centre for in-service training of teachers,
3. As a reference library and distribution centre for books, etc.

In June 1969, Mr. Sutherland retired and the following October Mr. Donn Barrieau was appointed Reading Coordinator.

The VSBRC today still operates as a treatment centre for children who are severely retarded in reading and also as a demonstration centre for the in-service training of teachers. In addition, the Reading Centre also serves as a 'back-up' unit for the many Learning Assistance Centres (L. A. C. 's) which have been established in elementary schools since 1971.

In its role as a treatment centre for children with severe reading problems, the VSBRC currently caters to the needs of fifteen children who are considered to require more help than the L. A. C. 's can provide. The fifteen children selected for the VSBRC program represent only a small percentage of the number of cases referred to the Centre.

Most children attending the VSBRC have a learning problem which is caused by their lack of ability to read adequately. The Centre therefore places most instructional emphasis on reading and basic language communication skills. Arithmetic and other core subjects are also incorporated into the program.

Mr. Donn Barrieau, the Reading Coordinator in charge of the VSBRC, has outlined the basic procedure followed at the Centre.



"The content of each child's program consists of science, social studies, art and physical education, even though such activities are directed on an oral basis of communication through human speech or recorded voice. The children are on individual programs of study whenever possible during the first term to accommodate their different achievement levels, methods and rates of learning. During the second term an increasing amount of time is given to group activities and short formal lessons in social studies and science. Half way through the year children who are able to succeed in a subject (e. g. art) taught in a regular classroom situation are given the opportunity to do so in the nearby Carr Elementary School. Thus begins the careful transition back into the classroom."<sup>1</sup>

The VSBRC places equal stress on the personal development of the students enrolled in its program. As Mr. Donn Barrieau points out:

"In their first two or three years of school, the children have experienced much failure, and consequently have developed such behaviour patterns as aggression, disruption, and withdrawal which are difficult to cope with in a regular class. To change this behaviour the children are given success experiences and freedom from forced competition. Behaviour modification techniques, group discussion and fair play for all are a part of the daily routine."<sup>2</sup>

The main functions of the VSBRC are thus twofold:

1. To develop individual students academically, socially, and emotionally to the stage where they can begin to benefit from regular classroom instruction.
2. To enable children to realize their potential as members of society and to permit their positive contribution to the progress of that society.

A number of supportive statements by the staff of the VSBRC which contribute to the overall goals of the Reading Centre have been included in Appendix A.

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<sup>1</sup>Personal communication to the writers. (April 14, 1973)

<sup>2</sup>ibid

### ILLUSTRATIONS\*

The following two pages contain illustrations of the types of activities used in the VSBRC program.

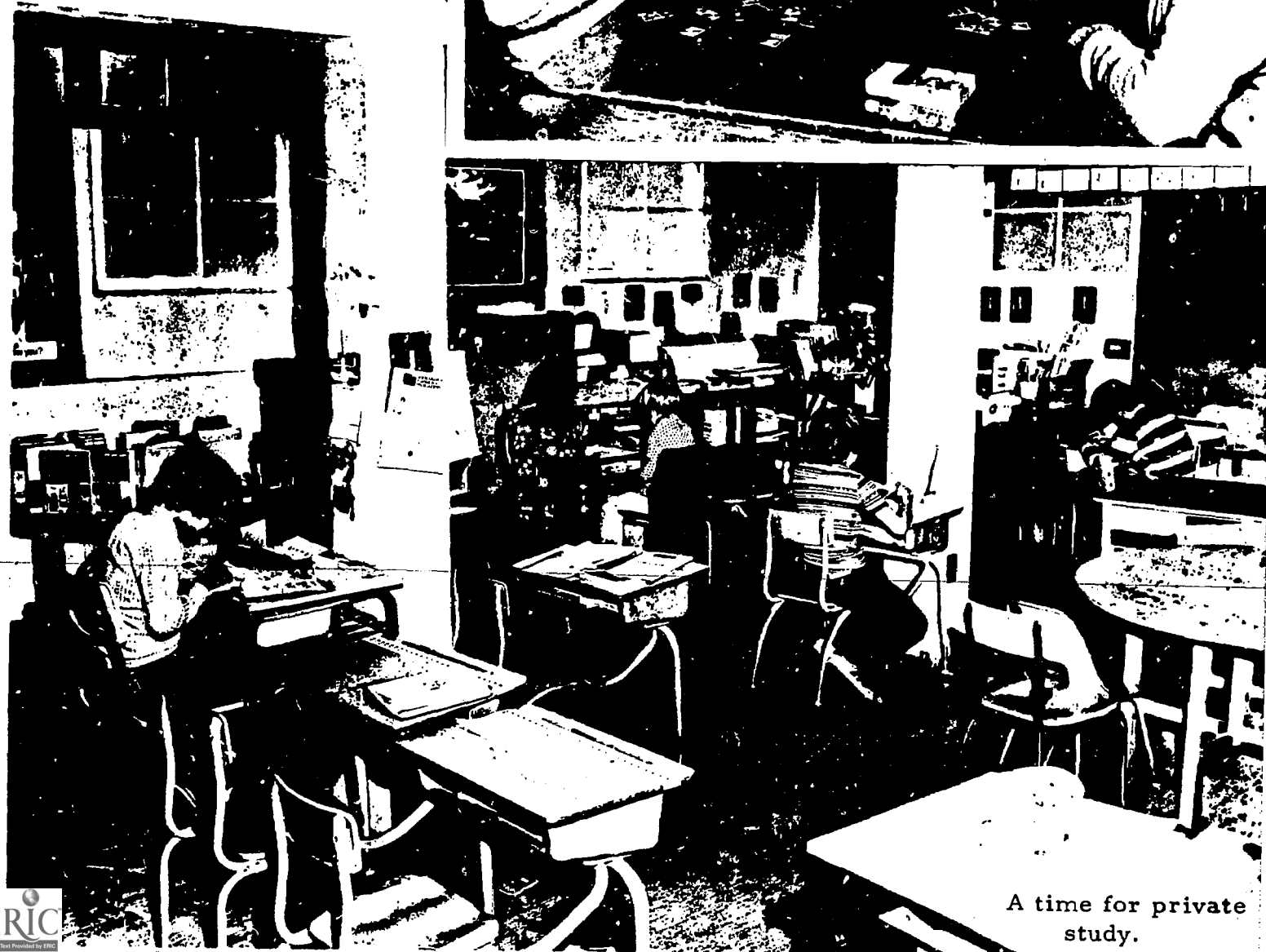
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\*The pictures in this Report were taken by Marjean Borjesson, the Board's photographer.



Learning to understand  
the "building blocks" of  
reading.

Working together  
can be fun.



A time for private  
study.



Top Left:

Developing creative abilities through  
problem-solving.

BEST COPY AVAILABLE

Below:

Learning is individualized.



Arithmetic skills are  
stressed.

## The Problem and its Significance

It is vitally important for the Reading Coordinator and the teachers of the VSBRC to obtain feedback about the effects of their program. They need to know whether children being instructed at the Centre are benefitting from the special assistance they are receiving.

A telephone survey of classroom teachers who were working with pupils formerly enrolled in the 1970-71 program at the VSBRC was conducted in 1972. This survey provided a good deal of useful information but was limited to fourteen questions about the pupils' academic, social, and emotional behaviour.

A great deal more needed to be known about the former pupils of the VSBRC who were now attending various elementary schools in the district. The data from an extensive study of these children would provide a sound basis upon which the staff of the VSBRC could evaluate their teaching methods and the total learning situation provided by the Centre. Such an analysis would also provide a starting point for a longitudinal study of children from the VSBRC.

## Purpose of the Study

The study was requested by the VSBRC and the Education Department of the Vancouver School Board. The study was designed to obtain information regarding the progress in regular classes of former pupils of the VSBRC.

Four specific areas were examined: academic skills, personal adjustment, social adjustment, and effort and motivation.

The main purpose of the study was to use the information gathered to answer the following questions:

1. To what extent have the pupils enrolled in the VSBRC during 1971-72 benefitted from their experience?
2. After receiving instruction at the VSBRC are pupils able successfully to re-enter and make progress in a regular class?

In addition it was hoped that the results would provide valuable feedback to the Reading Coordinator and staff at the VSBRC regarding the organization and development of their program.

## Limitations

All data used in the study were obtained from classroom teachers who were involved with the pupils concerned. As a result, it was not possible to standardize all teacher responses, although a limited number of basic categories were used. The lack of standardization precluded statistical treatment of the data.

The study, therefore, is mainly a descriptive-subjective analysis of teacher judgment of the issues involved. This is not to say that such an analysis is of little worth. Rather it serves to point out the nature of the study.

No attempt was made to analyze the teaching methods employed or the instructional materials used at the VSBRC.

The findings can only apply to the twelve students who participated in the study. Any inferences from these findings should be made with considerable caution. It is to be hoped, however, that the model used in this investigation will provide guidelines for future more rigorous, more extensive research designs.

## II. REVIEW OF RELATED LITERATURE

Remedial Reading Programs are beginning to form an integral part of modern educational systems. Today, thousands of students across North America are receiving special instruction in reading which enables most of them to return to the mainstream of school learning. (Harris 1967)

Shiffman (1971) outlined some of the major administrative problems involved in treating children with severe reading problems. Another educator emphasized the main aspect to consider in a remedial reading program.

1. Identify retarded readers in first and second grades and begin remedial instruction as early as possible.
2. Regular classroom teachers should refer children who are below grade level in reading according to standardized test results and/or the teachers' evaluations of daily performance.
3. Formal and informal evaluation should be used to select those children who are at least 25% below average and who have the greatest intellectual potential.
4. Children with social, emotional, and physical abnormalities should not be excluded if they meet other criteria. (Byrne, 1972)

The VSBRC follows a very similar procedure to the one presented by Byrne (1972).

Bond and Tinker (1967) stated that remedial work in reading should be with children who have an I. Q. of 90 or higher. These children and their parents should both want to participate in the program and the children should be those whose main deficiency is in reading. The need for accurate and thorough diagnostic work in selecting students for a reading clinic was stressed by Hollingsworth (1970). He suggested an interdisciplinary approach where a team of experts from related disciplines examined students in reading performance, behaviour, mental ability, medical background, and family attitudes which may contribute to the learning problem. The very careful



screening process employed by the VSBRC ensures that the above takes place.

The remedial reading program is not meant to be a permanent method of instruction for all students who participate. Because children's needs can change rapidly, the remediation should also be capable of great adaptability to cater to new situations. By focussing attention on the specific needs of each child, the remedial reading teacher is able to develop individualized programs of instruction. (Bond and Tinker 1967). Numerous behavioural problems can be circumvented in this manner. This aspect of the program was stressed by Mr. Donn Barrieau, the Reading Coordinator, in his 1971-72 Report.

Ideally, pupils should be scheduled for remedial instruction each day with periods of work approximately 40 minutes in duration. Small numbers of students (about 5) should constitute groups so that learning experiences can be shared. (Byrne 1972) The children's successes should be emphasized as an aid to motivation. Humphrey (1970) has pointed out that meaningful activities and methods must be utilized by the teachers. For this reason, the remedial reading teacher must have sufficient time for diagnostic work, preparing instructional materials, and coordinating other aspects of the program. Byrne (1972) suggested that both sufficient time and money should be allocated for in-service work before and during the remedial reading program. In a similar vein, McMenemy (1971) urged special training for reading specialists to facilitate greater attention to be given to the readiness of individual students and their needs.

The integration of pupils who have been on a remedial program back into the classroom situation is another area of vital concern. When children return to the classroom after a lengthy period of remediation they should gradually assume their own responsibilities under the direction of the teacher. (Bond and Tinker, 1967) It is the classroom teacher's task to follow up the work of the remedial reading specialist and gradually adapt the student to a developmental program if possible. In many instances remedial work may still be required for students and a cooperative effort between classroom teacher and a reading specialist should be arranged. In other cases, pupils may receive assistance in reading for a short period of time each day and then return to the classroom. Whichever procedure is adopted, it is desirable to have a policy of continuous assessment for pupils who are emerging from a remedial reading program.

A study conducted by the Department of Planning and Evaluation for the Vancouver School Board, showed that although the VSBRC was providing a valuable and necessary service, a good deal more work needed to be done. Many of the teachers and principals who were polled in the survey pointed to the need to have more time available for remedial reading specialists to help classroom teachers with their problems. They also felt that the VSBRC should be expanded to cater for many more students and also to provide a wider variety of services. Both teachers and principals praised the work being carried out by the Reading Centre in enabling students to gain a better self-image and to resume participation in the regular program of instruction. (Reid, 1972)

### III. METHODOLOGY

#### Design

A one-group, pre-treatment, post-treatment design was used in the study. Many of the inherent weaknesses in the design pointed out by Campbell and Stanley (1963) were not relevant because of the absence of a test component.

A control group was not used because of the difficulty of matching control subjects with the experimental group. It would also have been difficult to obtain an accurate assessment of control subjects at the beginning of the 1971-72 school year.

#### Subjects

Twelve students out of the fifteen who had attended the VSBRC in 1971-72 were used in the study. The other three students had left the district.

#### Instruments

A questionnaire (see Appendix B) which contained a section on "Skills" (academic) and a section utilizing Barclay's (1972) "Classroom Climate Inventory" dealing with behaviour was used to obtain data. Teachers responding to the questionnaire used a number of measuring devices (informal reading inventories, standardized tests, etc.), but those were not used by the researchers.

#### Procedure

The principals of the schools involved in the study were first contacted by letter (see Appendix C). The questionnaire with an explanatory letter (see Appendix D) was then issued to the teacher in charge of each of the twelve students. Copies of the same letter and questionnaire were also sent to the Reading Coordinator and staff at the VSBRC.

The teachers were asked to estimate the current level of their student's academic ability in a number of sub-skills and also to indicate characteristics of behaviour on the "Classroom Climate Inventory" section of the questionnaire. The staff at the VSBRC supplied similar information on each student for the pre-treatment analysis.

When all questionnaires had been completed and returned, the teacher's responses in the academic "Skills" section were converted to the following categories: "very good", "good", "average", "fair", "slow/weak", "poor". These results along with teacher responses to the "Classroom Climate Inventory", were then tallied and used for a comparative assessment.



#### IV. RESULTS

##### A. Academic Findings

The total number of teacher-assessments for eight selected academic skills is summarized in TABLE I. A discussion of the results in each academic skill follows:

TABLE I: NUMBER OF STUDENTS AT EACH LEVEL OF PERFORMANCE IN EIGHT ACADEMIC SKILLS  
ON PRE-TREATMENT AND POST-TREATMENT ASSESSMENT

Skills	V. Good		Good		Average		Fair		Slow/Weak		Poor		No Respons	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Listening Comprehension	0	1	5	1	3	3	2	1	1	2	1	3	0	1
Visual Perception	0	-	0	2	0	4	2	1	4	0	2	2	4	3
Auditory Perception	0	1	0	1	0	3	0	2	3	0	9	1	0	4
Phonic Abilities	0	0	0	1	0	2	0	1	3	5	9	3	0	0
Word Analysis/ Vocabulary	0	0	1	0	1	2	4	3	2	4	4	3	0	0
Oral Reading and Recall	0	0	0	1	0	4	0	3	3	1	9	3	0	0
Silent Reading and Recall	0	0	0	0	0	3	0	2	3	2	9	5	0	0
Arithmetic Skills	0	2	2	4	5	3	2	0	0	1	3	1	0	1
TOTALS	0	4	8	10	9	24	10	13	19	15	46	21	4	9

### Listening Comprehension

Students for the most part did better on the pre-treatment than on the post-treatment (See Figure 1). While no students were classified as "very good" on the pre-treatment, five were rated as "good", compared to one "very good" and one "good" on the post-treatment. There were fewer students classified as "poor" and "slow/weak" on the pre-treatment compared to the post-treatment. This result could be partly due to the fact that the staff at the VSBRC had more sophisticated means of measuring listening comprehension and thus were more stringent in their assessment. Also, the extra attention that the students received at the Reading Centre could have detracted from their listening performance in a different learning situation.

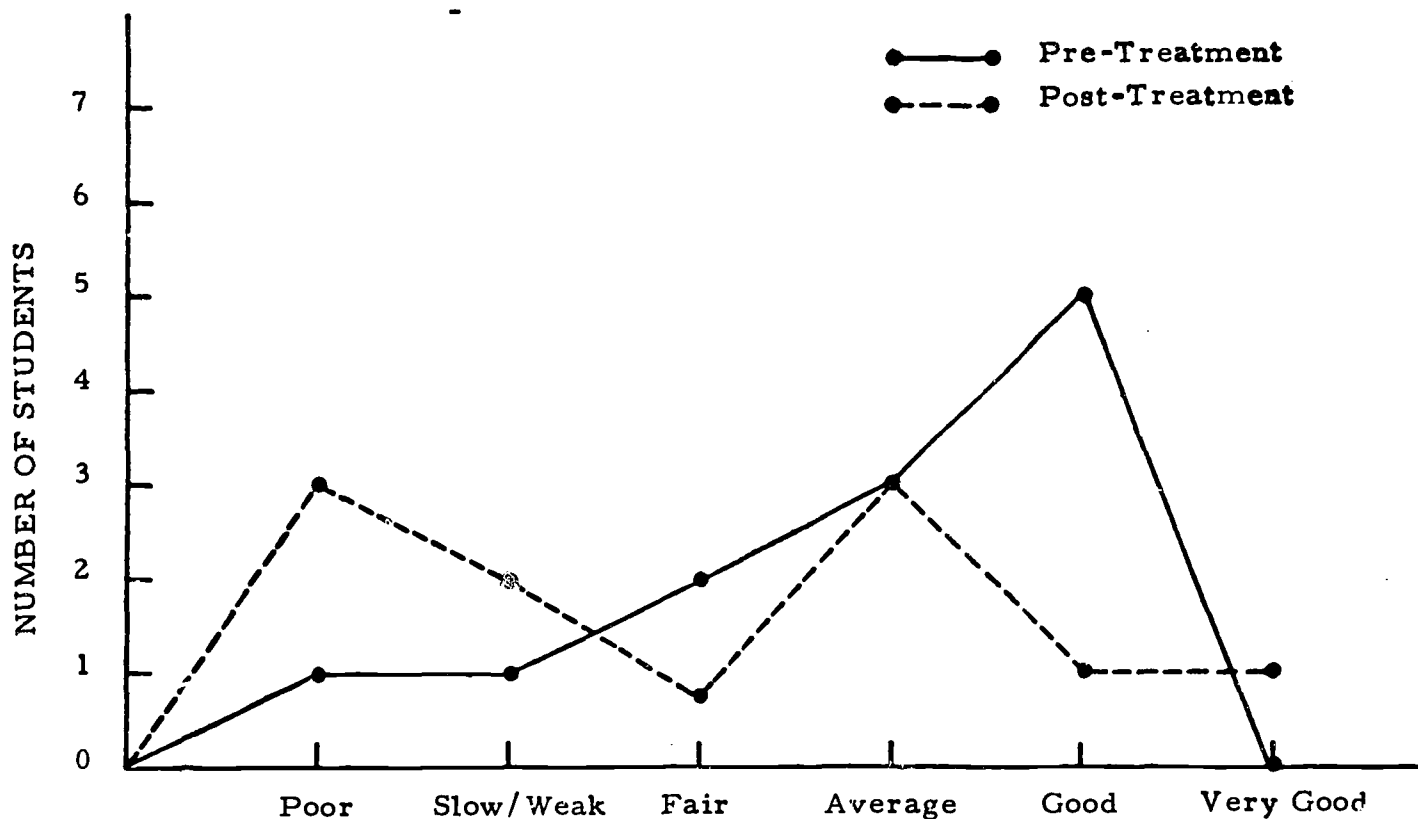
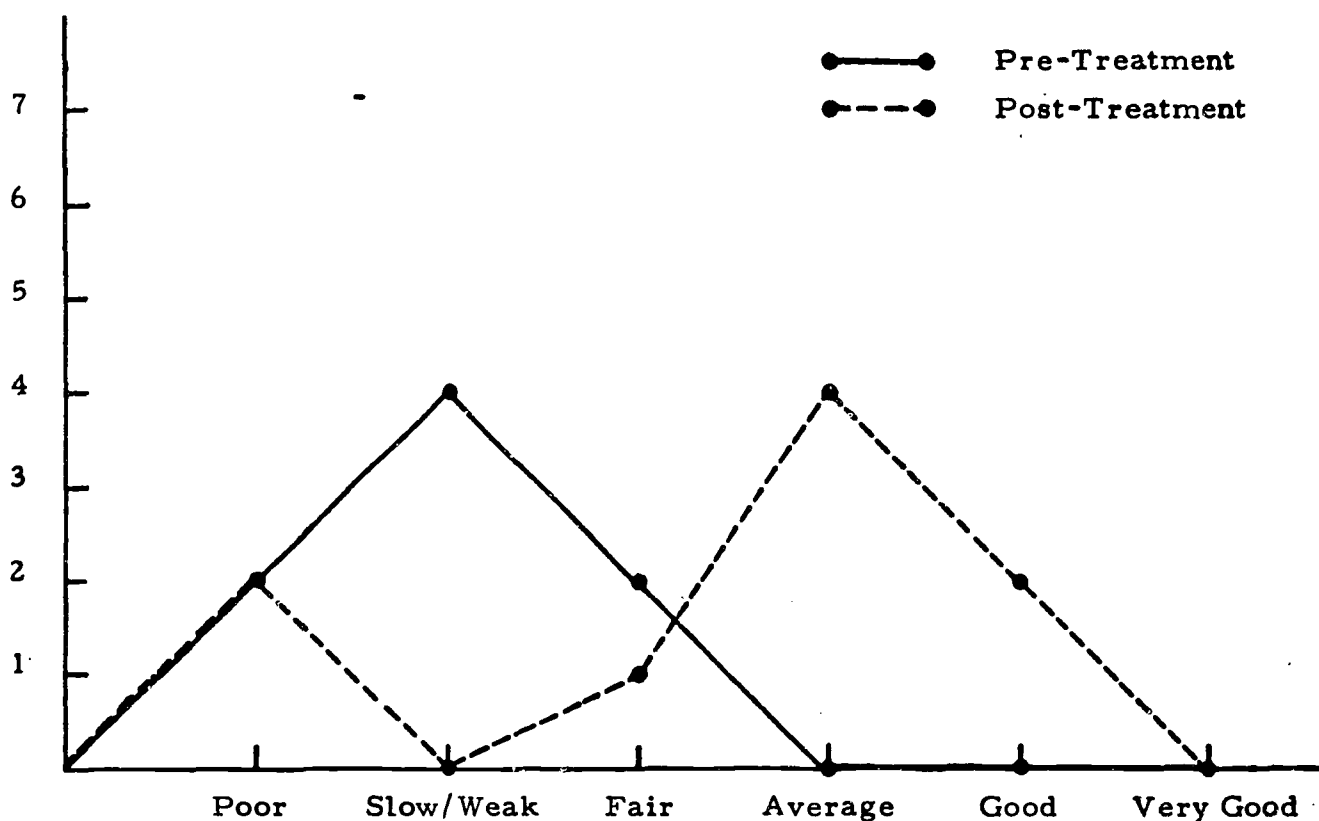


FIGURE 1: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS OF STUDENTS IN LISTENING COMPREHENSION

### Visual Perception

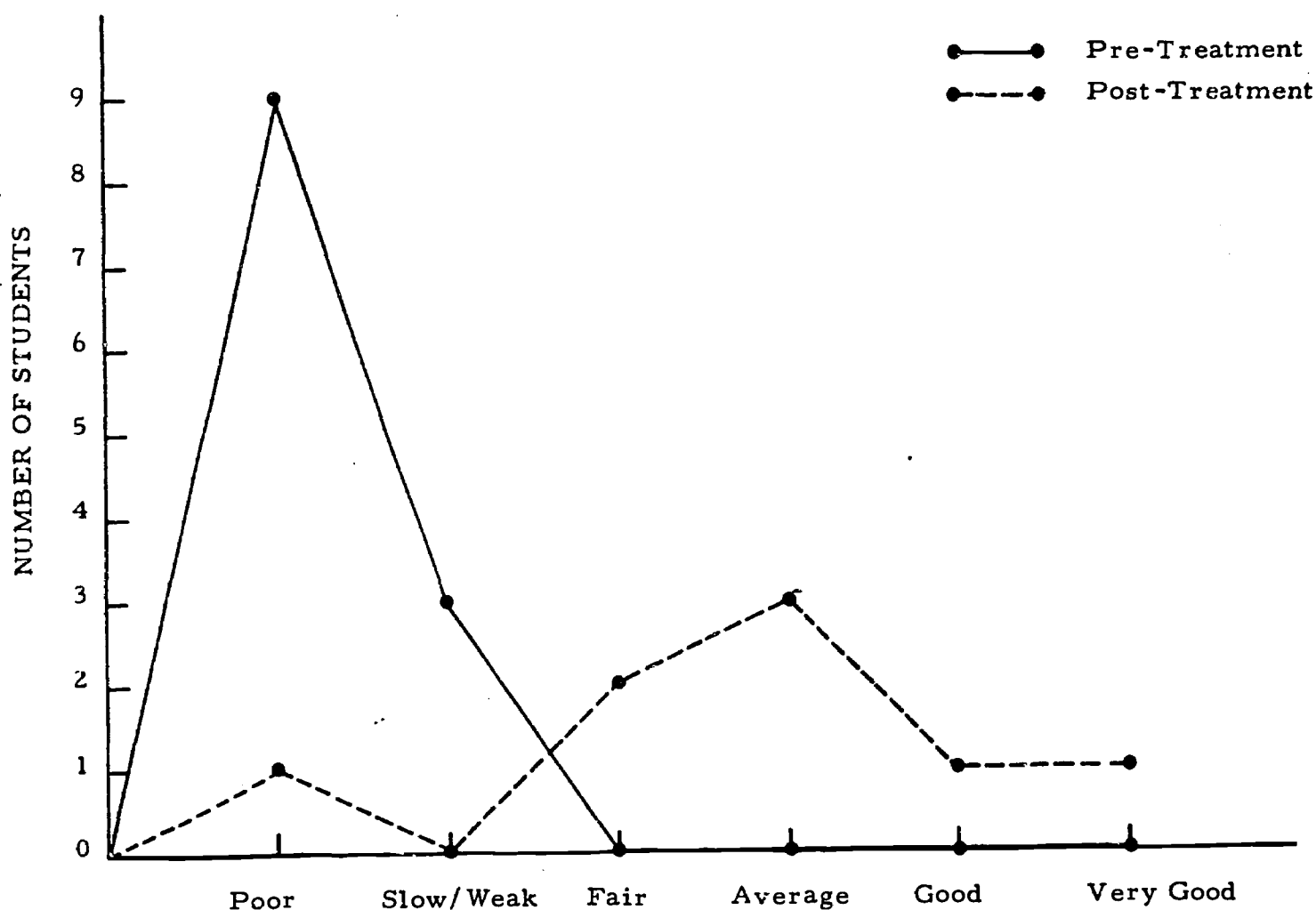
Considerable improvement was shown in this basic reading-related skill. (See Figure 2). Six of the twelve pupils were rated as "good" or "average" on the post-treatment whereas all of the pre-treatment assessments were classed as "fair" to "poor".



**FIGURE 2: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS OF STUDENTS IN VISUAL PERCEPTION**

### Auditory Perception

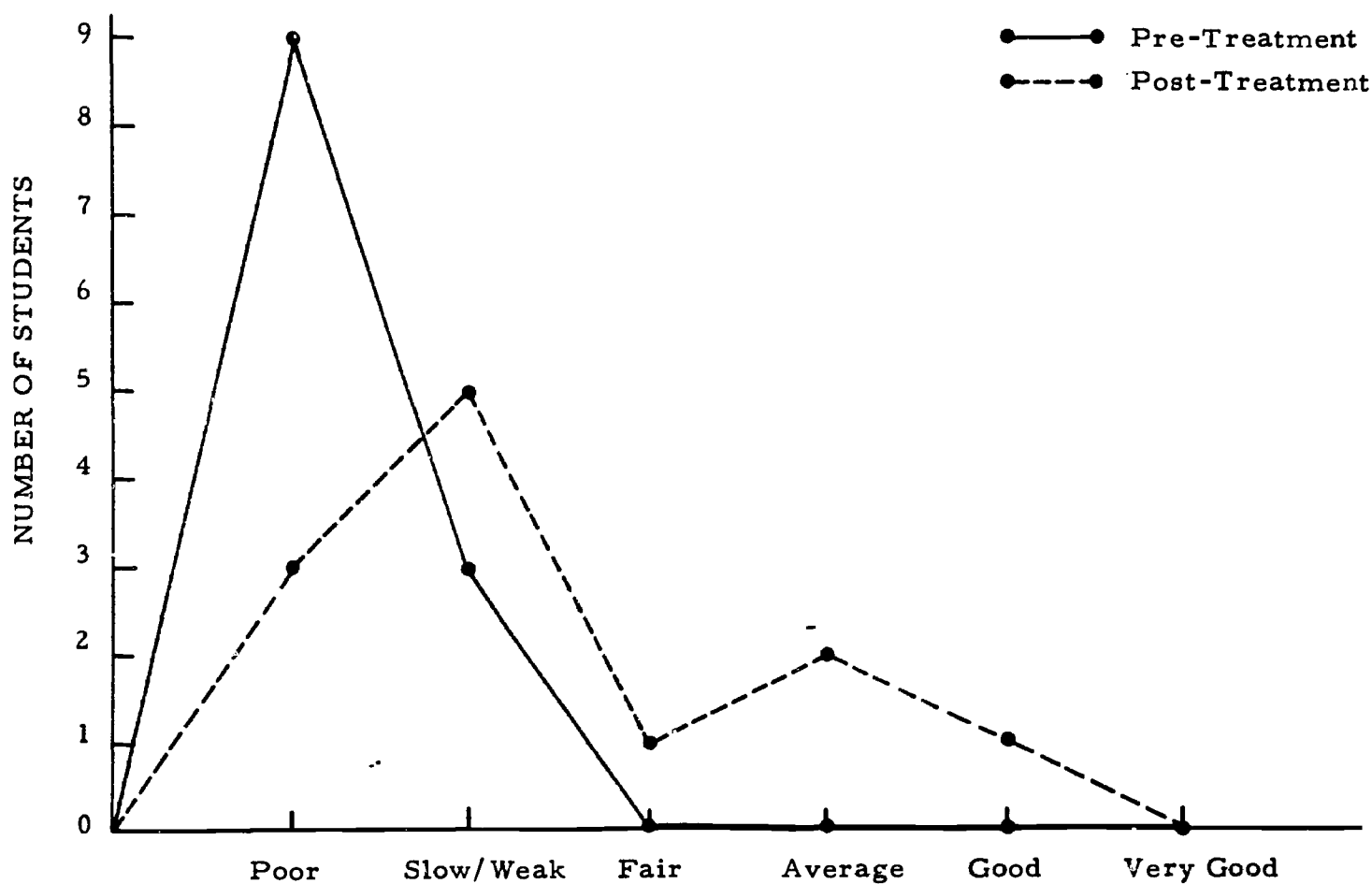
The positive effect of the VSBRC was also evident in this skill. (See Figure 3) Five of the pupils were assessed as "average" or better on the post-treatment while the pre-treatment assessment rated three students "slow/weak" and nine students "poor".



**FIGURE 3: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS OF STUDENTS IN AUDITORY PERCEPTION**

### Phonic Abilities

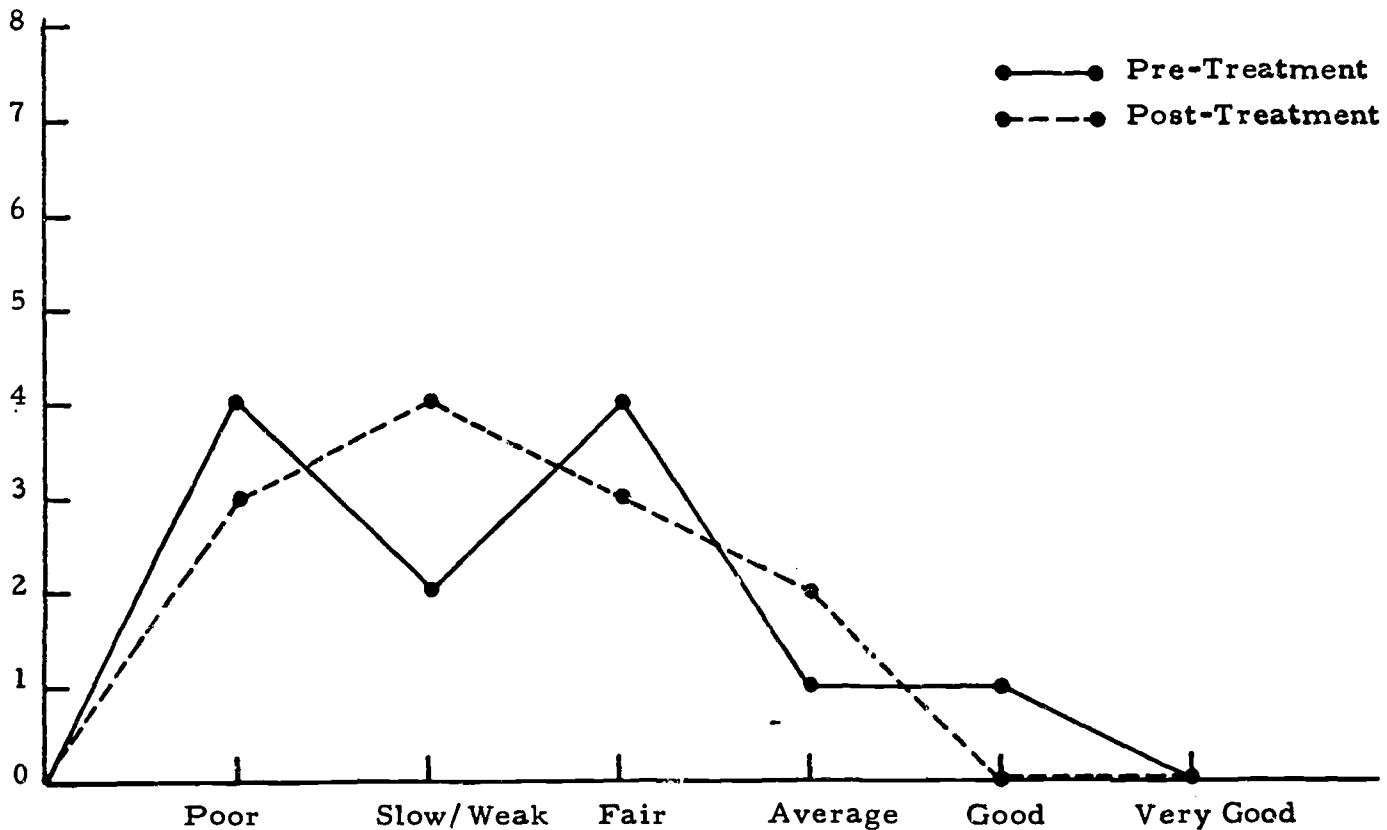
The results of the pre-treatment assessment were the same as those in Auditory Perception with all students rated "slow/weak" or "poor". The post-treatment results showed that although there were still eight pupils in the same two categories, four other students had improved considerably. (See Figure 4)



**FIGURE 4: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS OF STUDENTS IN PHONIC ABILITIES**

### Word Analysis/Vocabulary

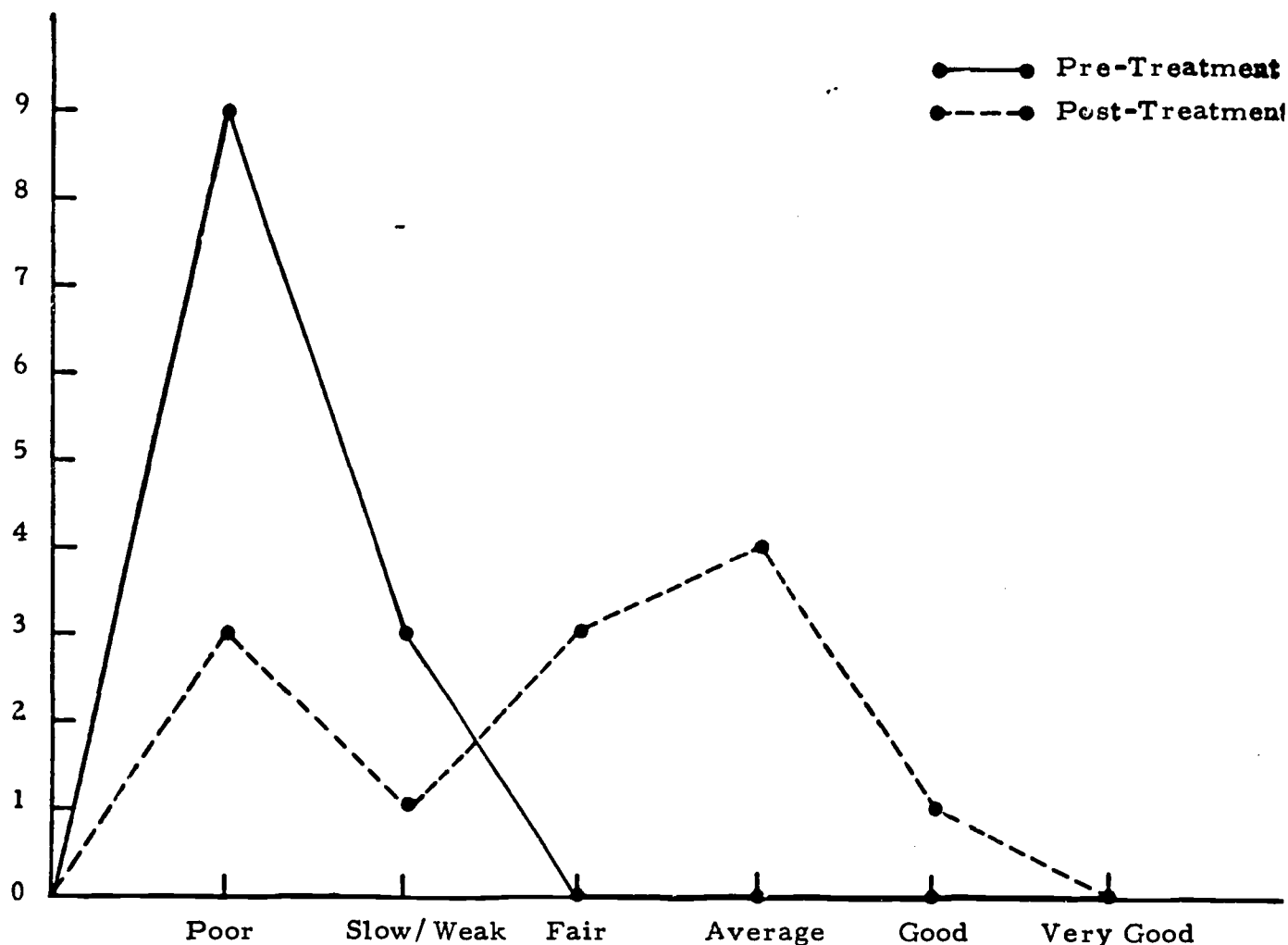
Little change was evident in this skill. (See Figure 5) In many cases word analysis and vocabulary are treated out of context. The general improvement made by the pupils in reading ability suggests that other factors such as the use of content clues may have been operating.



**FIGURE 5: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS  
OF STUDENTS IN WORD ANALYSIS/VOCABULARY**

### Oral Reading and Recall

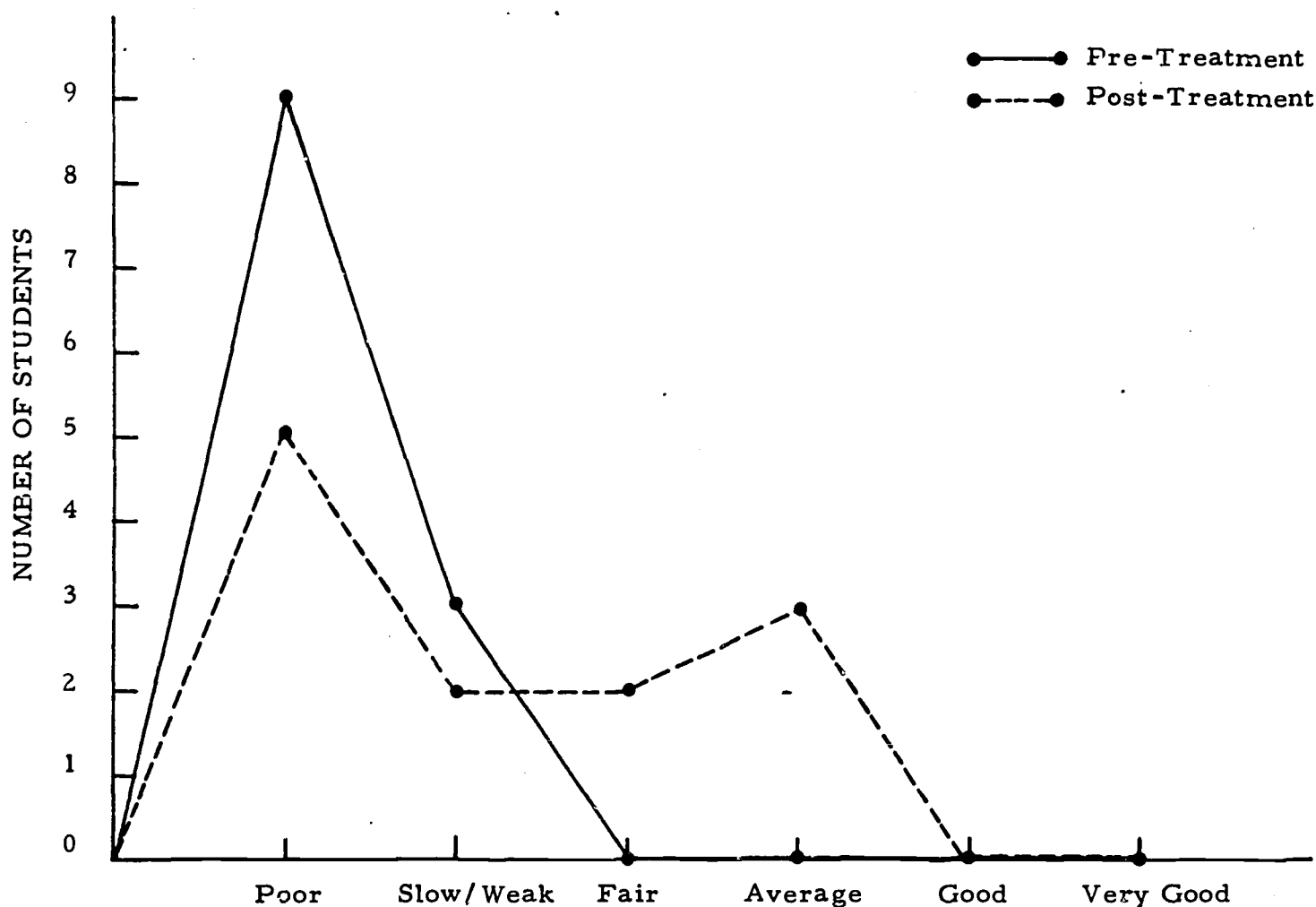
The substantial improvement made between the pre- and post-treatment assessments is illustrated in Figure 6. At the beginning of the program, nine of the twelve pupils were classed as "poor" readers. (Comments ranged from 'absolute non-reader' to 'not measurable by normative standards'). Three pupils were placed in the "slow/weak" category. The post-treatment assessment rated over half the students in either the "fair" category or better.



**FIGURE 6: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS OF STUDENTS IN ORAL READING AND RECALL**

### Silent Reading and Recall

The results in the pre-treatment phase were identical with the preceding reading skill. The improvement in silent reading was not as pronounced as the oral aspect. However, five students had progressed to the "fair" and "average" category by the post-treatment assessment. (See Figure 7)



**FIGURE 7: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS OF STUDENTS IN SILENT READING AND RECALL**



### Arithmetic Skills

The pupils made gains in this aspect of the VSBRC program. Two of the post-treatment ratings were "very good" and four were "good". This compared favourably with the two pre-treatment ratings of "good". More of the pre-treatment assessments were in the lower categories.

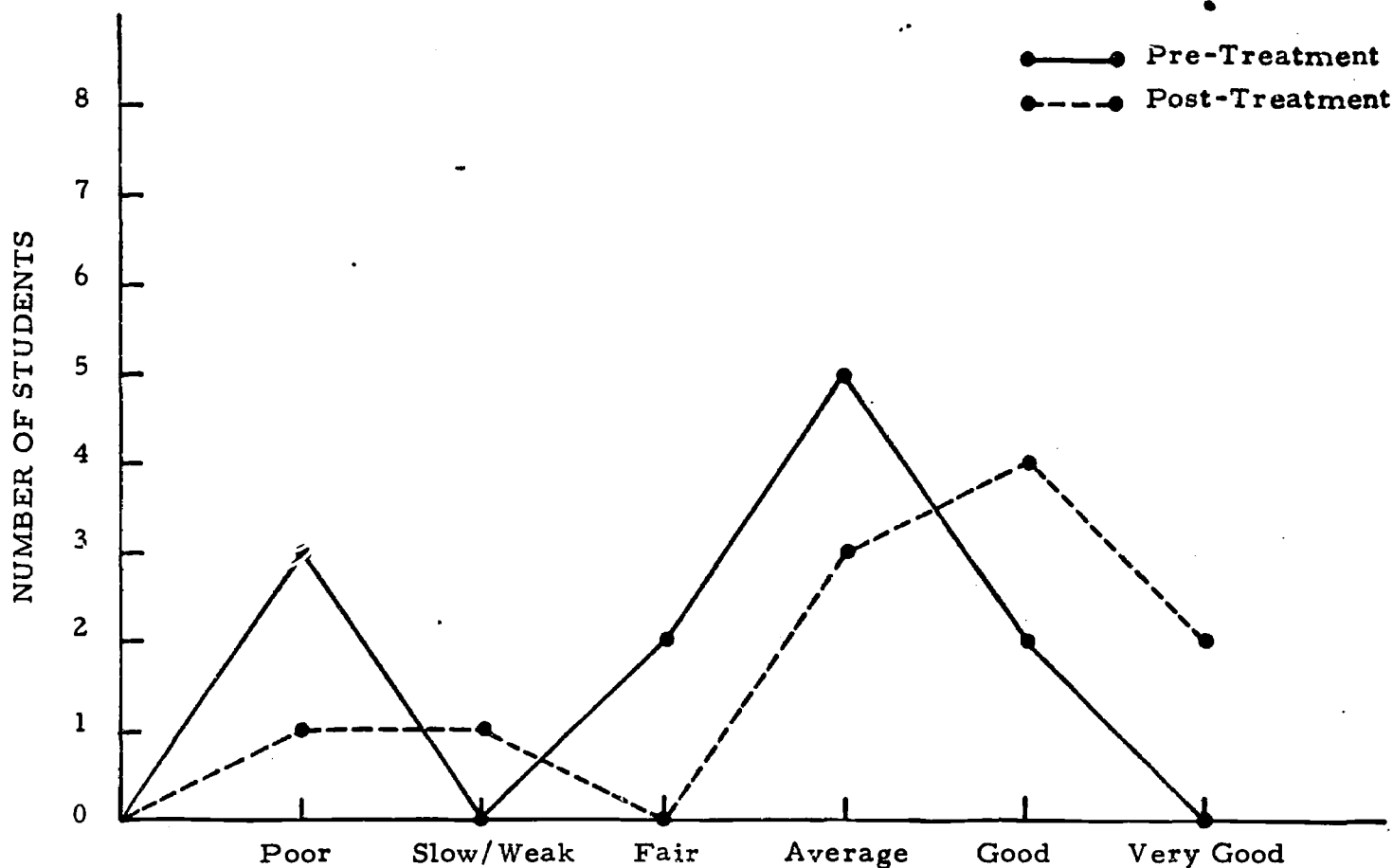


FIGURE 8: PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS  
OF STUDENTS IN ARITHMETIC SKILLS

## B. Behavioural Findings

The Classroom Climate Inventory consisted of three sections; Personal Adjustment, Social Adjustment, and Effort and Motivation. The 'desirable' and 'undesirable' traits within these sections were tallied separately and used in the analysis.

### Desirable Traits

The results of the Classroom Climate Inventory shown in Table II indicate that the behaviour modification techniques used by the staff at the Reading Centre had a beneficial effect on the pupils. In each of the three categories listed, far more instances of positive, constructive behaviour were noted. In the Personal Adjustment section there was a two-fold increase of desirable traits when comparing the post-treatment assessments with the pre-treatment. The other two sections of Social Adjustment and Effort and Motivation also showed substantial increases.

### Undesirable Traits

An analysis of the teacher assessment of students who displayed undesirable behavioural characteristics confirmed the findings outlined in the preceding discussion. There was a marked decrease between the pre- and post-assessments, of the number of pupils who were judged to have undesirable traits. This trend was most pronounced in the Social Adjustment section where over 70% of the undesirable traits listed had been removed by the time of the post-assessment. Similar trends in Personal Adjustment and Effort and Motivation were noted with a decrease of over 50% in the number of undesirable characteristics in both categories. (See Table III).

TABLE II: NUMBER OF PUPILS CONSIDERED TO POSSESS DESIRABLE TRAITS IN PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS

<u>Personal Adjustment Traits</u>	<u>Pre-Test</u>	<u>Post-Test</u>	<u>Social Adjustment Traits</u>	<u>Pre-Test</u>	<u>Post-Test</u>	<u>Effort and Motivation Traits</u>	<u>Pre-Test</u>	<u>Post-Test</u>
Secure	0	2	Considerate	4	6	Alert	3	4
Stable	0	2	Affectionate	0	2	Ambitious	1	2
Cooperative	3	9	Cooperative	2	7	Dependable	2	3
Mature	0	2	Kind	1	3	Systematic	1	2
Trustful	3	6	Humorous	2	3	Coordinated	0	1
Enthusiastic	3	5	Perceptive	2	3			
Cheerful	1	8	Trusting	2	4			
			Responsible	1	5			
			Outspoken	3	6			
<b>Totals</b>	<b>10</b>	<b>34</b>	<b>Totals</b>	<b>17</b>	<b>39</b>	<b>Totals</b>	<b>7</b>	<b>12</b>

TABLE III: NUMBER OF PUPILS CONSIDERED TO POSSESS UNDESIRABLE TRAITS IN PRE-TREATMENT AND POST-TREATMENT ASSESSMENTS

<u>Personal Adjustment Traits</u>	<u>Pre-Test</u>	<u>Post-Test</u>	<u>Social Adjustment Traits</u>	<u>Pre-Test</u>	<u>Post-Test</u>	<u>Effort and Motivation Traits</u>	<u>Pre-Test</u>	<u>Post-Test</u>
Passive	4	1	Unresponsive	5	0	Irresponsible	5	2
Withdrawn	3	0	Introverted	3	0	Uncoordinated	7	2
Distrustful	5	2	Lack of Humour	4	1	Unsystematic	7	5
Insecure	7	6	Unperceptive	6	2	Unintegrated	10	1
Moody	6	3	Unreceptive	5	2	Distractible	10	7
Anxious	6	4	Suspicious	4	1	Undependable	6	2
Aggressive	11	6	Inconsiderate	4	2	Persistent	5	3
						Pre-occupied	8	3
						Disorganized	7	2
						Confused	5	2
						Indifferent	6	2
						Unambitious	4	2
						Restless	9	5
<b>Totals</b>	<b>42</b>	<b>22</b>	<b>Totals</b>	<b>31</b>	<b>8</b>	<b>Totals</b>	<b>89</b>	<b>38</b>

## SUMMARY OF FINDINGS

### A. Academic Skills

The main effects of the VSBRC program as measured by the subjective evaluation of teachers was the progress made by the participating pupils in oral and silent reading ability as well as in the reading-related skills of visual perception, auditory perception and phonic abilities.

Considerable improvement was also apparent in arithmetic skills, but word analysis and vocabulary did not improve while the listening ability of the pupils showed a decline.

### B. Behavioural Characteristics

The VSBRC program (which utilizes behaviour modification techniques) had a marked effect on pupil-behaviour. The incidence of improved behavioural traits in the post-treatment assessment ranged from over 200% gain for Personal Adjustment, over 100% gain for Social Adjustment, to some 70% gain for Effort and Motivation.

A similar analysis of the number of incidences of students whose undesirable behaviour showed a decline during their stay at the VSBRC produced results of nearly 50%, over 70%, and a 56% reduction for Personal Adjustment, Social Adjustment, and Effort and Motivation, respectively.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

The VSBRC program is having a beneficial effect on a number of students who have severe learning problems. In particular, the VSBRC caters for those students who need more help than the Learning Assistance Centres can provide, and the progress in regular classes of these former students of the VSBRC has been very encouraging.

The program of the VSBRC concentrates on a number of basic academic skills and also makes use of behaviour modification techniques. Both areas of academic skills and student behaviour improved considerably during the VSBRC program, according to teacher assessments. It would appear that the improvement in basic academic skills among the students resulted in their better behavioural patterns. However, there could have also been a reverse process at work. Perhaps the emphasis on student behaviour which was conducive to good study habits was the main reason for the improvement in performance in academic skills.

The most likely explanation is that the total program offered by the VSBRC is proving successful. This would include the stress on basic academic skills, the attention given to procedures which reinforce good classroom behaviour, the dedication of the coordinator and staff, plus outside support for the Centre.

### Recommendations

A number of recommendations pertaining to the VSBRC program and to further research studies of this nature are suggested:

#### Recommendations for the VSBRC Program

1. That greater emphasis be placed on listening comprehension,
2. That a closer look be given to methods of presenting word analysis and vocabulary,
3. That further consideration be given to the area of silent reading and recall where five students were still rated as "poor" in the post-treatment assessment,
4. That an attempt be made to find the possible connection between the undesirable traits of "aggressive", "unsystematic", "distractible", and "restless" (frequently reported in the post-assessment), with the individualized program of instruction for each student.

#### Recommendations for Further Research

1. That studies be designed to analyze and relate the teaching methods and instructional materials used at the VSBRC with the progress of the students.
2. That carefully selected standardized instruments be used to assess the growth of students in various areas during the program.
3. That there be used in future research a control group of pupils who have been "matched" with the experimental subjects so that a comparative assessment may be made.
4. That a longitudinal study of the participating pupils be made so that long term effects of the VSBRC program and the follow-up work of the schools may be assessed. (The present study could serve as a data base for the experimental group.)

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## APPENDICES

## APPENDIX A

### Statements of Objectives for the Vancouver School Board Reading Centre:

- Mrs. T. Hyland
- Mr. J. Pritchard
- Miss J. Loney

VANCOUVER SCHOOL BOARD READING CENTRE  
4070 Oak Street,  
Vancouver 9, B. C.

Objective: To equip our kids to benefit from regular classroom teaching by:

A. Academics

- progressing as far along in the course of studies of the core subjects as is possible given the limitations of the child, the physical surroundings, and the pupil-teacher ratio.

B. Getting Along with Teachers

- learning appropriate classroom behaviours
- learning to function as a member of a group
- learning to follow a sequence of instructions
- learning to learn from their own successes and errors

C. Getting Along with Kids

- learning the rules of fair play
- learning to communicate without resorting to aggression
- learning to understand that others have problems too

(Mrs.) T. Hyland  
Learning Assistance Teacher

TH:dg

VANCOUVER SCHOOL BOARD READING CENTRE  
4070 Oak Street,  
Vancouver 9, B. C.

OBJECTIVES

1. To provide the pupil with a warm, protective environment where he is free to progress at his own speed without undue pressure and competition.
2. To give each child as much individual attention, assistance, and counselling as possible.
3. To place him on an academic programme that fits his needs and to give him a series of success experiences at his level of competence.

A child who feels secure - who is happy - and who experiences success is more liable to learn.

4. To give the pupil an intellectual understanding of the reading process.
5. To imbue a thorough knowledge of the phonic code.
6. To increase his sight vocabulary.
7. To create a solid foundation on which the pupil can build his reading skills.
8. To assure that each pupil is capable of reading independently at some level of competency.
9. To ward off the debilitating effects of continual failure and to give the pupil an opportunity to catch his breath and to find himself. The preventative aspects of therapy can not be disregarded.

Mr. J. Pritchard,  
Reading Teacher.

## GOALS FOR READING CENTRE

April 13, 1973.

Children attending the reading centre have been referred by classroom teachers to the Reading Coordinator. The child's reading disability is such that he has become discouraged and frustrated and thus unable to perform in the regular classroom.

Children attending have been thoroughly screened medically and school board psychological testing has been accomplished. Medical screening includes vision, audio physical examination and also an assessment of emotional health and behaviour attitude of the child. If physical examination indicates neurological testing is necessary this should be accomplished prior to attendance at the reading centre.

Medical treatment should be established prior to attendance for this concentrated specialized programme at the reading centre. Children with severe emotional or psychological problems should have these well assessed and efforts made to rectify some of these problems prior to attending the reading centre.

Parents need to be well aware of reading problems and the reason the child has been selected to attend this class. The parents' full cooperation and understanding is a must.

The goals of this classroom are:

- To make a genuine effort to improve the child's reading to an extent that he can return to the regular classroom,
- To build up the child's confidence so he will again make an effort to learn in the regular classroom.

To achieve these goals the child must be at optimum health and attend regularly.

J. Loney  
School Nurse

## APPENDIX B

### Questionnaire on Student's Progress

ATTENTION: \_\_\_\_\_

QUESTIONNAIRE ON STUDENT'S PROGRESSStudent's Name \_\_\_\_\_  
(Last) (First)

Sex: M F

School: \_\_\_\_\_

Grade: \_\_\_\_\_

	Year	Month	Day
Date:			
Birthdate:			
Age:			

TEACHER: Please assess as accurately as possible, the student's level in the following areas. You may state a grade level, or a group level, or simply comment on the situation.  
(NOTE: Some of the categories listed may not apply to your student(s)).

SKILL	ASSESSMENT
Listening Comprehension	
Speech	
Visual perception	
Auditory perception	
Phonic abilities	
Learning rate	
Reading interest and effort	
Word analysis/vocabulary	
Oral reading and recall	
Silent reading and recall	
Spelling	
Study abilities	
Arithmetic skills	
Other subjects	
Special problems	

## CLASSROOM CLIMATE INVENTORY

**INSTRUCTIONS:** Please mark the boxes in front of the adjectives which normally apply to this student. Use your general impression of the student as the basis of your judgment.

### PERSONAL ADJUSTMENT

- |   |  |   |   |   |
|---|--|---|---|---|
| 1. <input type="checkbox"/> Active        | 2. <input type="checkbox"/> Uninterested | 3. <input type="checkbox"/> Secure      | 4. <input type="checkbox"/> Stable      | 5. <input type="checkbox"/> Open        |
| 6. <input type="checkbox"/> Passive       | 7. <input type="checkbox"/> Withdrawn    | 8. <input type="checkbox"/> Cooperative | 9. <input type="checkbox"/> Distrustful | 10. <input type="checkbox"/> Depressed  |
| 11. <input type="checkbox"/> Confident    | 12. <input type="checkbox"/> Insecure    | 13. <input type="checkbox"/> Moody      | 14. <input type="checkbox"/> Mature     | 15. <input type="checkbox"/> Trustful   |
| 16. <input type="checkbox"/> Enthusiastic | 17. <input type="checkbox"/> Cheerful    | 18. <input type="checkbox"/> Cautious   | 19. <input type="checkbox"/> Anxious    | 20. <input type="checkbox"/> Aggressive |

### SOCIAL ADJUSTMENT

- |  |  |   |  |  |
|--|--|---|--|--|
| 21. <input type="checkbox"/> Considerate   | 22. <input type="checkbox"/> Unresponsive  | 23. <input type="checkbox"/> Affectionate | 24. <input type="checkbox"/> Introverted | 25. <input type="checkbox"/> Cooperative |
| 26. <input type="checkbox"/> Kind          | 27. <input type="checkbox"/> Lack of Humor | 28. <input type="checkbox"/> Unperceptive | 29. <input type="checkbox"/> Unreceptive | 30. <input type="checkbox"/> Humorous    |
| 31. <input type="checkbox"/> Perceptive    | 32. <input type="checkbox"/> Trusting      | 33. <input type="checkbox"/> Responsive   | 34. <input type="checkbox"/> Suspicious  | 35. <input type="checkbox"/> Silent      |
| 36. <input type="checkbox"/> Inconsiderate | 37. <input type="checkbox"/> Outspoken     |   |  |  |

### EFFORT AND MOTIVATION

- |  |  |   |   |   |
|--|--|---|---|---|
| 38. <input type="checkbox"/> Alert         | 39. <input type="checkbox"/> Irresponsible | 40. <input type="checkbox"/> Methodical | 41. <input type="checkbox"/> Controlled   | 42. <input type="checkbox"/> Organized    |
| 43. <input type="checkbox"/> Uncoordinated | 44. <input type="checkbox"/> Unsystematic  | 45. <input type="checkbox"/> Incomplete | 46. <input type="checkbox"/> Unintegrated | 47. <input type="checkbox"/> Distractible |
| 48. <input type="checkbox"/> Undependable  | 49. <input type="checkbox"/> Ambitious     | 50. <input type="checkbox"/> Dependable | 51. <input type="checkbox"/> Persistent   | 52. <input type="checkbox"/> Preoccupied  |
| 53. <input type="checkbox"/> Disorganized  | 54. <input type="checkbox"/> Confused      | 55. <input type="checkbox"/> Systematic | 56. <input type="checkbox"/> Coordinated  | 57. <input type="checkbox"/> Indifferent  |
| 58. <input type="checkbox"/> Thorough      | 59. <input type="checkbox"/> Unambitious   | 60. <input type="checkbox"/> Restless   | 61. <input type="checkbox"/> Responsible  | 62. <input type="checkbox"/> Divergent    |
| 63. <input type="checkbox"/> Involved      |  |   |   |   |



## APPENDIX C

### Letter to Principals

DEPARTMENT OF PLANNING  
AND EVALUATION



BOARD OF SCHOOL TRUSTEES  
OF SCHOOL DISTRICT NO. 39 VANCOUVER

1595 WEST 10TH AVENUE  
VANCOUVER 9, B.C.  
TELEPHONE: 731-1131

January 24, 1973.

Dear Principal: -

We would like to enlist your cooperation in a study we are conducting for the Vancouver School Board Reading Centre.

Would you please pass the enclosed letter and questionnaire on to the teacher concerned.

Thank you for your assistance in this matter.

Yours sincerely,

PETER EDWARDS,  
for  
Department of Planning and Evaluation  
Vancouver School Board.

PE:dn  
Encs.

## APPENDIX D

### Letter to Teachers

DEPARTMENT OF PLANNING  
AND EVALUATION



BOARD OF SCHOOL TRUSTEES  
OF SCHOOL DISTRICT NO. 39 (VANCOUVER)

1595 WEST 10TH AVENUE  
VANCOUVER 8, B.C.  
TELEPHONE: 731-1131

January 24, 1973.

Dear Teacher:

We are trying to determine if a number of children who received instruction at the Vancouver School Board Reading Centre during 1971-72 are still benefitting from their remedial program.

Would you please spare a few minutes of your time to complete the enclosed questionnaire? If you have queries relating to this study don't hesitate to contact us at 731-1131 (local 285 or 286).

Thank you for your assistance in this matter.

Yours sincerely,

PETER EDWARDS

for

Department of Planning and Evaluation  
Vancouver School Board.

PE:dn  
Enc.

## DOCUMENT RESUME

ED 088 915

TM 003 471

AUTHOR Durward, M. Lynne  
TITLE Computer-Assisted Instruction in Arithmetic at South Hill Elementary Scho 1.  
INSTITUTION Vancouver Board of School Trustees (British Columbia). Dept. of Planning and Evaluation.  
REPORT NO RR-73-08  
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IDENTIFIERS Canada

## ABSTRACT

Grade six and seven students at South Hill Elementary School were involved in the study to evaluate computer-assisted instruction (CAI) in arithmetic. The pupils were divided into three groups: the members of the "Computer Group" each received five minutes of CAI in arithmetic per day in addition to regular arithmetic classes, the "Help Group" received five minutes of group instruction per day in addition to regular arithmetic classes, and the "Zero Group" received no additional instruction. Pre- and post-tests in arithmetic were administered. A questionnaire, designed to determine the attitudes of the pupils towards the computer experiment, their evaluation of its effectiveness and their opinions on possible modifications to the system, was administered. The teacher involved was asked to give his impression of the project. The results indicated that: computer-assisted instruction improves arithmetic skills, and CAI in addition to regular classroom instruction is superior to an equivalent amount of classroom instruction in improving arithmetic skills. None of the results, however, was statistically significant. The students and the teacher considered the project to be beneficial. It was thought, however, that pupils at a lower grade level would benefit more from this particular application of CAI. (Author/RC)



ED 088915

TM 003 471

## RESEARCH REPORT

**BEST COPY AVAILABLE**

Computer-Assisted Instruction in Arithmetic  
at South Hill Elementary School

May 1973

M. Lynne Durward  
Research Report 73-08

DEPARTMENT OF PLANNING AND EVALUATION  
Board of School Trustees  
1595 West 10th Avenue  
Vancouver 9, B.C.

COMPUTER-ASSISTED INSTRUCTION IN ARITHMETIC  
AT SOUTH HILL ELEMENTARY SCHOOL

---

May 1973

M. Lynne Durward

Research Report 73-08





BEST COPY AVAILABLE

Teacher Barry Macdonald and pupil Cheri Lechner work on the terminal.

Ray Allan Photo  
Courtesy Vancouver Sun



## ACKNOWLEDGMENTS

The Department of Planning and Evaluation gratefully acknowledges the assistance of Mr. Wayne Dodds, Computer Consultant at the Vancouver School Board; Mr. Barry Macdonald, instructor at South Hill Elementary School; and Miss Helen Ward, instructor at John Oliver Secondary School, for their assistance on many aspects of this study.

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## ABSTRACT

Grade six and seven students at South Hill Elementary School were involved in the study to evaluate computer-assisted instruction (CAI) in arithmetic. The pupils were divided into three groups: the members of the "Computer Group" each received five minutes of CAI in arithmetic per day in addition to regular arithmetic classes, the "Help Group" received five minutes of group instruction per day in addition to regular arithmetic classes, and the "Zero Group" received no additional instruction. Pre- and post-tests in arithmetic were administered to measure gains in proficiency. A questionnaire, designed to determine the attitudes of the pupils towards the computer experiment, their evaluation of the effectiveness of the computer-assisted instruction, and their opinions on possible modifications to the system, was administered to the Computer Group. In addition, the teacher involved in the study was asked to give his impressions of the project.

The results of the study suggested that:

- a) computer-assisted instruction in addition to regular classroom instruction improves arithmetic skills, and
- b) CAI in addition to regular classroom instruction is superior to an equivalent amount of classroom instruction in improving arithmetic skills.

None of the results, however, was statistically significant. Both the students and the teacher considered the project to be beneficial. It was thought, however, that pupils at a lower grade level, who had not yet mastered the basic arithmetic skills, would benefit more from this particular application of CAI. A second study, similar to the first but employing grade four and five pupils, was outlined. The revised procedures, based on the findings of the first study, were noted.

# COMPUTER-ASSISTED INSTRUCTION IN ARITHMETIC AT SOUTH HILL ELEMENTARY SCHOOL

---

## Introduction

In recent years, the use of computers to aid in teaching has become increasingly popular. The applications of such computer-assisted instruction (CAI) are many; they range from drilling pupils in elementary arithmetic to teaching university students how to pronounce foreign language words.<sup>1</sup>

The introduction of CAI to Vancouver elementary schools occurred in March, 1973, when a group of sixth and seventh grade pupils from South Hill Elementary School became involved in an experiment to determine the effectiveness of CAI in improving basic arithmetic skills. The results of that study, and their implications for more extensive and sophisticated applications of CAI, are presented in this report.

## CURRENT RESEARCH ON CAI

Current literature abounds with examples of the effectiveness of computer-assisted instruction in reducing the time required to attain mastery of a subject. For example, Grubb and Sefridge found that:

Using CAI, the students in one half of a course on psychological statistics... covered the material in 5.3 hours compared with 49 hours for the lecture mode and 12.2 hours for the programmed text. The average achievement score in the CAI mode was 94.3 compared with 58.4 in the lecture mode.<sup>2</sup>

A research team from Leeds University in England found computer-assisted instruction to be of value in teaching arithmetic to primary school pupils. The speed of addition of the youngsters improved by 50 per cent, with far fewer errors. The headmaster, who was quite enthusiastic about the program, commented:

All the evidence collected so far from some 2,000 pupil-hours at computer terminals... suggests considerable promise for our system in facilitating pupil performance.<sup>3</sup>

---

<sup>1</sup>Uttal, W. R., "Teaching and Machines", Psychology Today, August, 1967, pp. 20-23.

<sup>2</sup>Grubb, R. E. and Lenore D. Sefridge, "Computer Tutoring in Statistics and Coursewriter", Computers and Automation, Vol. 13, No. 3, March 1963. Cited in William D. Hedges, "Computer-Assisted Instruction and the Schools", Educational Leadership, Jan., 1973.

<sup>3</sup>Parry, Mark, "The Ultimate Aid and Its Future", Education, 18 August 1972, Vol. 140, No. 7, p. 125.

Suppes and Searle studied the effect of CAI on the acquisition of computational skills by elementary school pupils in California and Mississippi. The gain in computation scores was significantly greater for those in the experimental classes using CAI than for those in the control classes for three of the six grades in California and for all six grades in Mississippi. The researchers noted that, in general, the Mississippi control groups performed more poorly than the California control groups. It was their opinion that if the Mississippi children were given a total of five to ten minutes of work on the teletype throughout the six elementary grades, their performance on computational skills could be brought up to the level of Californian children without CAI.

Enthusiasm on the part of the pupils involved in CAI projects appears to be universal. Suppes and Searle, commenting on CAI in general, conclude:

The response of the children has been very favourable. Many adults have expressed concern about the impersonality of interacting with a computer-- or rather, its representative, the teletype. The children, though, with their great ability to personify the inanimate, talk to, even yell at, hit and kick the teletype and advise others to avoid the machines 'that give hard problems'. Working at a teletype is more engrossing for the student than the usual classroom situation. Each action brings a quick, relevant, individual response, and a demand for further action. Engaging the attention of the student is a crucial prerequisite for learning arithmetic skills and concepts, and a teletype in action certainly is an attention-getting device.<sup>4</sup>

Many adults have also expressed concern about computers replacing teachers, but this too is an unfounded fear. The main function of the computer is to assist teachers:

The computer relieves the teacher of the dreary and time-consuming task of correcting drill exercises, keeps records, and diagnoses areas of students' strengths and weaknesses. The teacher can use the diagnoses for designing special instruction for individual students and can devote the class time previously applied to drill to more imaginative activities.<sup>5</sup>

It is thus evident from the majority of research studies to date that computer-assisted instruction can be of considerable value to both students and teachers.

---

<sup>4</sup>Suppes, Patrick and Barbara Searle, "The Computer Teaches Arithmetic", School Review, February, 1971, pp. 216-217.

<sup>5</sup>Ibid., p. 225.

## METHODOLOGY

### THE EXPERIMENTAL DESIGN

Eighty-seven pupils in grades six and seven at South Hill Elementary School participated in the study. A pre-test of arithmetic skills<sup>6</sup> was administered to the pupils, and they were then assigned to three groups: a "Computer Group", a "Help Group", and a "Zero Group". A completely randomized grouping was not possible. The pupils had been asked prior to the experiment whether they would like to work on the computer and it was requested by the instructor that those pupils who had expressed such desires be included in the Computer Group.

The members of the Computer Group received arithmetic drill on the teletype for approximately five minutes per day; this was in addition to their regular arithmetic classes. A detailed explanation of the procedures followed by this group is presented in the next section.

The Help Group received five minutes of group instruction per day in addition to their regular classes in arithmetic. This extra help included blackboard drills (in which the pupils competed with each other to get the correct answer in the shortest time); flash card drills in simple multiplication, addition and subtraction; and five-minute quizzes. The Help Group was drilled on approximately the same problem types as the Computer Group.

No additional instruction outside of the regular arithmetic classes was given to the Zero Group.

The duration of the study was six weeks. At the end of that time, post-tests in arithmetic were administered to the three groups. Statistical analyses were made by using "t" tests to determine if the difference between the groups (in terms of the gains made between the pre- and post-tests) were significant.

Following the post-testing, the pupils in the Computer Group were asked to complete a questionnaire (see Appendix C). The aim of the questionnaire was to determine the attitudes of the pupils towards the computer experiment, their evaluation of the effectiveness of the computer-assisted instruction, and their opinions on possible modifications to the system.

In addition, Mr. Barry Macdonald, who supervised the project, was asked to give his impressions of the program.

---

<sup>6</sup> Two equivalent forms of an arithmetic test developed by the Department of Planning and Evaluation were used. In order to control for practice effects, those pupils who took Form I for the pre-test took Form II for the Post-test and vice-versa. The two forms of the test are presented in Appendices A and B.



## DESCRIPTION OF THE DRILLING PROCEDURES FOR THE COMPUTER GROUP

Mr. Wayne Dodds, computer consultant for the Vancouver School Board, and Mr. Barry Macdonald developed a program in BASIC language to drill the pupils in computational skills. A computer terminal, connected by telephone line to the Hewlett-Packard computer at John Oliver Secondary School, was installed in the Media Center at South Hill Elementary School.

The program was designed to drill pupils on 24 problem types. (Examples of the problem types are included in Appendix D). To begin the program, a pupil typed a number from 1 to 100 on the computer terminal keyboard.<sup>7</sup> The pupil then entered the number of the problem type he wished to work on, and a computer-generated problem of that type was produced. He was required next to key in his answer, and was subsequently told either that his answer was "CORRECT", or "WRONG. CORRECT ANSWER IS...".

In order to advance to a higher level (a more difficult problem type), a pupil had to get ten problems correct in the set he was working on. The base number of problems allotted was ten, but an additional problem was added for each wrong answer keyed in, until a maximum of 13 problems was reached by the student. Thus, if a student made two errors, he was given a total of twelve problems, ten of which he had to get correct before being allowed to proceed to the next problem type. Otherwise, he had to begin another set of the same problem type.

Approximately five minutes were allotted for each student. If a pupil finished one problem type well within the five minutes, he was permitted to proceed to the next level. A seventh grade student who was not part of the Computer Group acted as monitor and recorded the daily time spent and the levels reached for each child.

A sample of the printout produced in a typical five-minute session on the terminal is presented in Appendix E.

---

<sup>7</sup> A random number generator was built into the computer program. Selecting a number from 1 to 100 enabled the student to "step into" the series of random numbers. All subsequent arithmetic problems would be constructed by the computer from the digits in the random number series following the "step-in" point.

## RESULTS

### PRE- AND POST-TEST SCORES

Two methods were used to analyze the differences between groups on the pre- and post-test measures: an analysis of "gain" scores (the difference between the post- and the pre-test scores) and an analysis of the ratio of gain scores to possible-gain scores (the difference between a perfect score and the score received on the pre-test).

Henry C. Ellis considered the measurement of gain to be a superior criterion of learning for the purpose of evaluating teaching effectiveness of programs, but cited some limitations of the gain score that suggested that it might be appropriate to use a measure of gain/possible-gain as well:

... if the pre-test measurement of achievement is high, then there is little room for possible gain in achievement. Gain scores may be misrepresentative and may appear unusually small because of high initial scores.<sup>8</sup>

This was, in fact, the case in the present experiment: several pupils attained scores of 23 or 24 out of a possible score of 24 on the pre-test. Those who achieved perfect scores on the pre-test (and who therefore would have no possibility of gain on the post-test), were not included in the gain/possible-gain analyses.

Since the Zero Group received no additional instruction, it may be assumed that any gain in scores could be attributed to such factors as the effectiveness of the regular mathematics classes in teaching arithmetic skills and general maturation of the students. (All three groups have the same instructor for their regular classes). Thus any differences between the treatment groups (Computer and Help Groups) and the no-treatment group (the Zero Group) should be attributable to the effect of the treatments themselves (and, of course, such factors as the "novelty effect" and motivation of the students).

The results showed that both the average gain and the average gain/possible-gain were highest for the Computer Group, second highest for the Help Group and lowest for the Zero Group, but none of the differences between the means of the groups was significant (see Tables I, II and III). The average gains between the pre- and the post-test scores for the three groups are presented in Figure 1.

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<sup>8</sup> Ellis, Henry C. "Judging the Teaching Effectiveness of Programs", in Trends in Programmed Instruction, Gabriel D. Ofeish & Wesley C. Meierhenry, eds., Department of Audiovisual Instruction, National Education Association of U. S., 1964, p. 208.

TABLE I: ANALYSIS BY "t" TEST OF GAIN SCORES AND GAIN/POSSIBLE-GAIN SCORES OF PUPILS IN THE "COMPUTER GROUP" AND THE "ZERO GROUP"

	Gain Scores		Gain/Possible-Gain Scores	
	Computer Group	Zero Group	Computer Group	Zero Group
No. of Pupils	28	29	27	27
Mean Score	2.50	1.24	0.34	0.16
Standard Deviation	2.78	2.53	0.37	0.40
Difference Between Means	1.26		0.18	
"t" Value	1.80 (n. s. d.)		1.66 (n. s. d.)	

Legend: n. s. d. --no significant difference

TABLE II: ANALYSIS BY "t" TEST OF GAIN SCORES AND GAIN/POSSIBLE-GAIN SCORES OF PUPILS IN THE "COMPUTER GROUP" AND THE "HELP GROUP"

	Gain Scores		Gain/Possible-Gain Scores	
	Computer Group	Help Group	Computer Group	Help Group
No. of Pupils	28	30	27	29
Mean Score	2.50	1.80	0.34	0.28
Standard Deviation	2.78	3.32	0.37	0.35
Difference Between Means	0.70		0.06	
"t" Value	0.86 (n. s. d.)		0.62 (n. s. d.)	

Legend: n. s. d. --no significant difference

TABLE III: ANALYSIS BY "t" TEST OF GAIN SCORES AND GAIN/POSSIBLE-GAIN SCORES OF PUPILS IN THE "HELP GROUP" AND THE "ZERO GROUP"

	Gain Scores		Gain/Possible-Gain Scores	
	Help Group	Zero Group	Help Group	Zero Group
No. of Pupils	30	29	29	27
Mean Score	1.80	1.24	0.28	0.16
Standard Deviation	3.32	2.53	0.35	0.40
Difference Between Means	0.56		0.11	
"t" Value	0.72 (n. s. d.)		1.13 (n. s. d.)	

Legend: n. s. d. --no significant difference

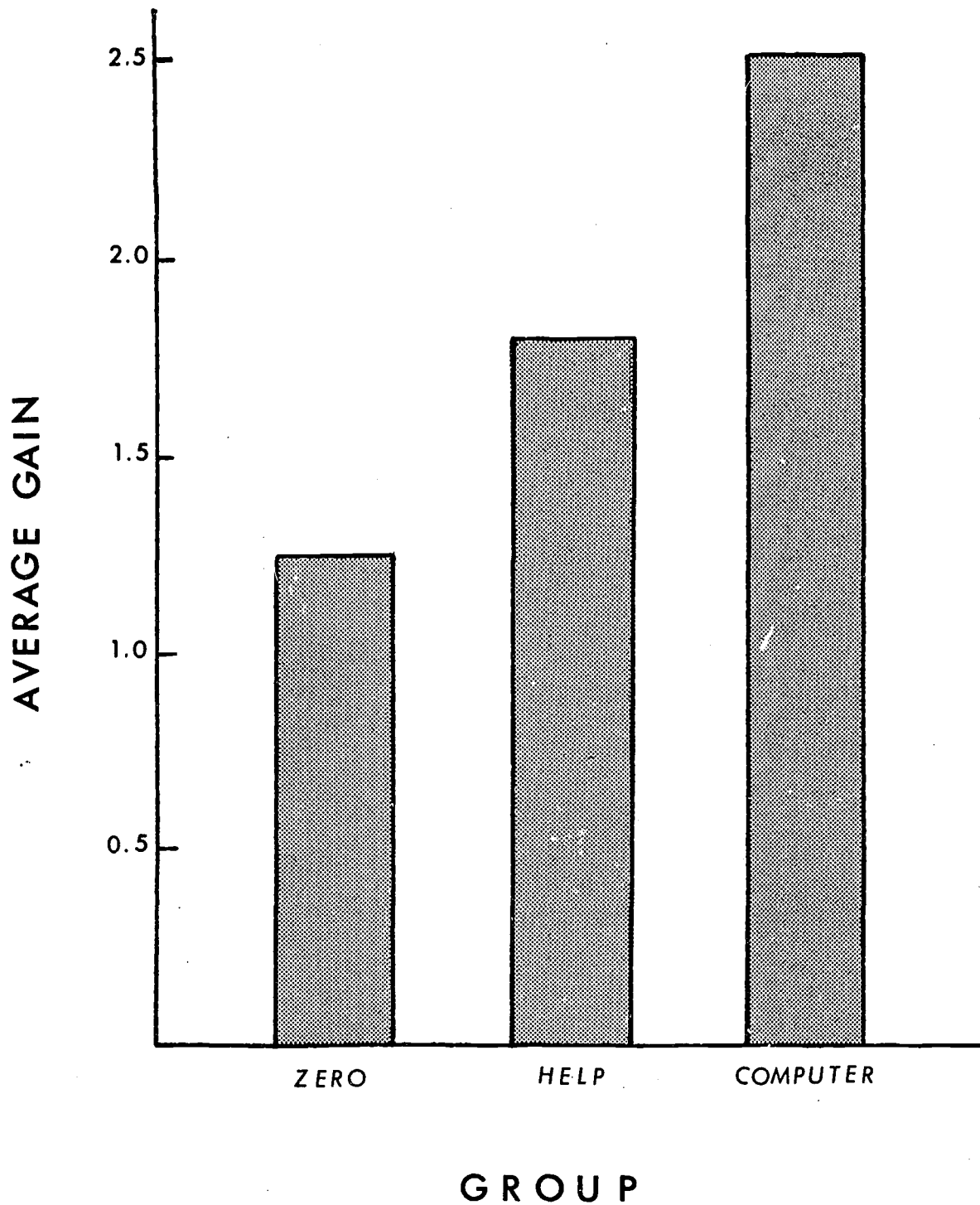


FIGURE 1: AVERAGE GAIN IN SCORE BETWEEN THE PRE- AND POST-TESTS FOR THE "ZERO GROUP", THE "HELP GROUP" AND THE "COMPUTER GROUP"

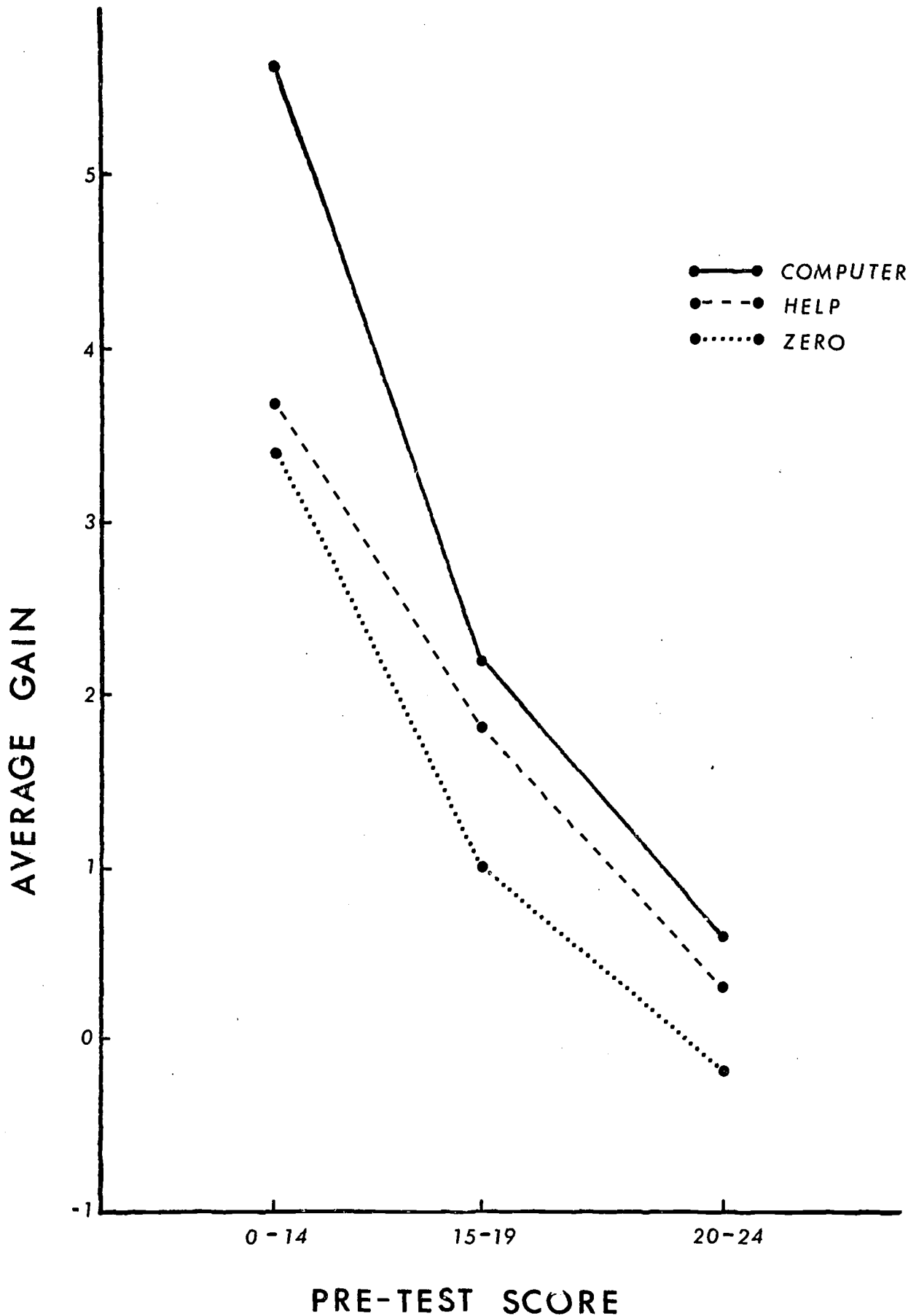


FIGURE 2: AVERAGE GAIN IN THREE PRE-TEST SCORE RANGES OF THE "ZERO GROUP", THE "HELP GROUP", AND THE "COMPUTER GROUP"

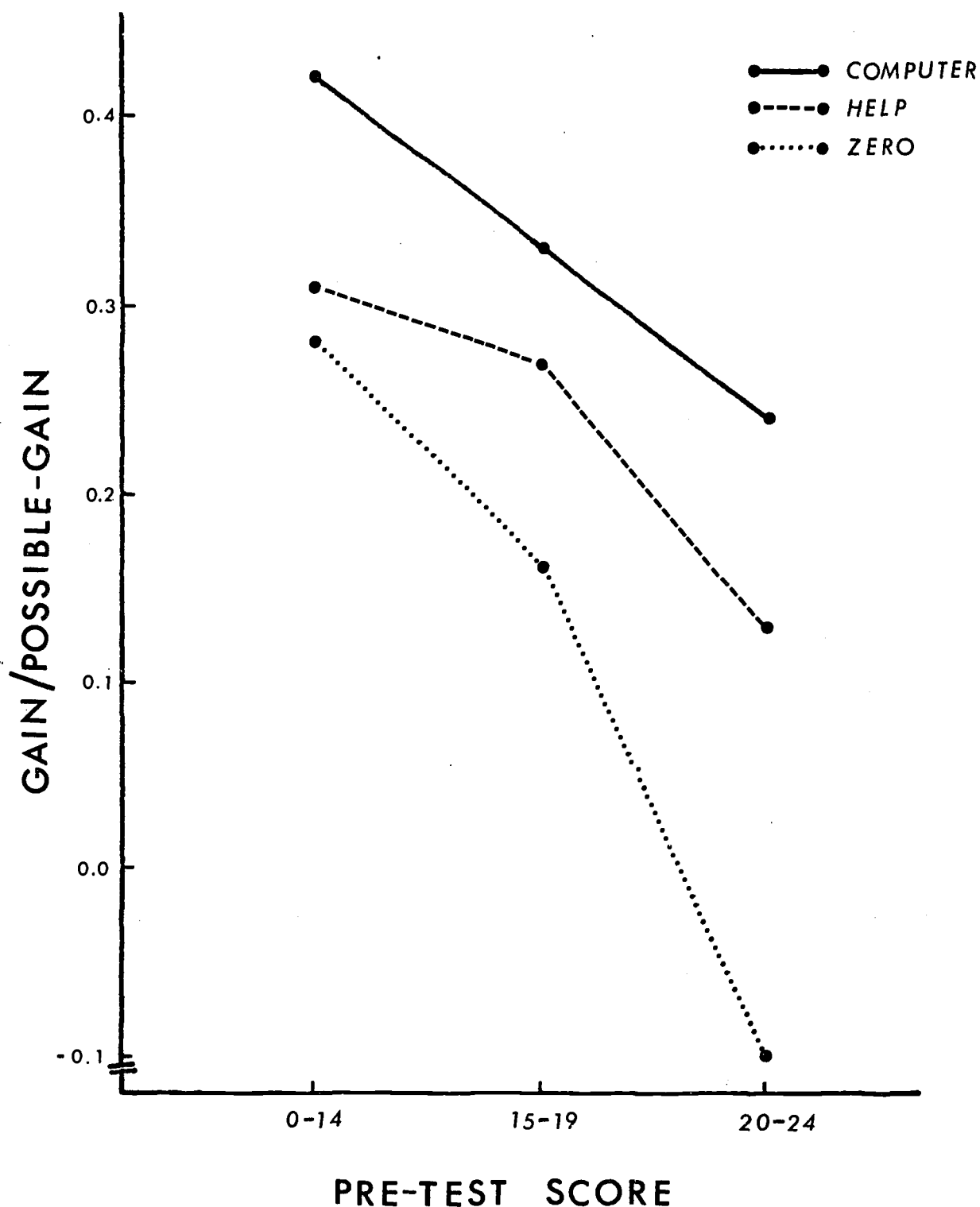


FIGURE 3: AVERAGE GAIN/POSSIBLE-GAIN IN THREE PRE-TEST SCORE RANGES OF THE "ZERO GROUP", THE "HELP GROUP", AND THE "COMPUTER GROUP"

The largest gains were made by those students with low scores on the pre-test, but then their potential for gain was the largest as well. Nevertheless, the pupils with low scores also had greater gain/possible-gain scores. Figures 2 and 3 illustrate the average gain and the average gain/possible-gain of pupils in the low pre-test score range (0-14), medium score range (15-19) and high score range (20-24).

#### STUDENT QUESTIONNAIRE ON CAI PROGRAM

Table IV presents a summary of the pupils' responses to the questionnaire.

TABLE IV: RESPONSES OF "COMPUTER GROUP" TO THE STUDENT QUESTIONNAIRE ON CAI PROGRAM

Item	% Response			
	"Yes"	"No"	"Sometimes"	"No Opinion"
1. I would like to continue with the program after Easter.	89.3	3.6	3.6	3.6
2. The teletype is too noisy.	39.3	42.9	10.7	7.1
3. The title takes too long to type.	89.3	7.1	3.6	-
4. The computer should not give the answer the first time you get it wrong--it should give you a second chance to get the correct answer.	46.4	46.4	-	7.1
5. The computer should not give the answer after the first time or the second time you get it wrong--it should give you a third chance.	14.3	75.0	-	10.7
6. I would prefer to have the questions on a T. V. screen.	35.7	42.9	3.6	17.9
7. The problems are too hard.	7.1	35.7	57.1	-
8. I like the date on my paper.	67.9	14.3	7.1	10.7
9. I like the title.	42.9	28.6	10.7	17.9
10. The problems are too easy.	17.9	28.6	53.6	-
11. I save my printout sheet.	78.6	-	17.9	3.6



TABLE IV: (Cont'd.)

Item	% Response			
	"Yes"	"No"	"Sometimes"	"No Opinion"
12. The teletype takes too long to type some questions.	60.7	14.3	25.0	-
13. The teletype waits too long between students.	67.9	17.9	3.6	10.7
14. Five minutes is not enough time.	50.0	25.0	17.9	7.1
15. I get wrong answers to many of the problems	7.1	46.4	32.1	14.3
16. I like having Monika there to help	71.4	3.6	17.9	7.1
17. I have to concentrate when at the teletype.	53.6	3.6	35.7	7.1
18. I wish the computer said "You goofed" instead of "Wrong".	50.0	32.1	3.6	14.3
19. After I type in the problem type, I like the computer repeating the problem type I asked for.	39.3	39.3	17.9	3.6
20. I can do arithmetic faster now.	82.1	3.6	10.7	3.6
21. I do not like working with the computer.	7.1	78.6	7.1	7.1
22. It is hard to read the questions.	10.7	42.9	42.9	3.6
23. It is boring.	7.1	75.0	10.7	7.1
24. I learn faster on the computer.	75.0	3.6	14.3	7.1
25. I don't like my level being shown on the big chart.	21.4	32.1	14.3	28.6
26. I would like to have the computer address me by name.	57.1	10.7	10.7	21.4
27. Computers make mistakes.	25.0	17.9	46.4	7.1
28. I find working on the computer interesting.	92.9	-	7.1	-

The attitude of the students towards the computer project was positive: 89.3% wished to continue with the program after Easter, 92.9% found working on the computer interesting, 82.1% believed they could do arithmetic faster now, and 75.0% thought that they learned faster on the computer. Only 7.1% (2 pupils) did not like working the computer; 7.1% found it boring.

The majority of pupils answered "sometimes" to both "The problems are too hard" and "The problems are too easy".

In regard to the operation of the computer terminal itself, the pupils were dissatisfied with the speed of the printer: 89.3% thought it took too long to type the title, 60.7% thought the teletype took too long to type some questions, and 67.9% thought it waited too long between students.

The students liked having the date printed on their sheet ("Yes" - 67.9%); they would like the computer to address them by name ("Yes" - 57.1%).

The pupils were divided on the question of receiving a second chance to get the correct answer to a problem they had missed, but were decidedly against ("No" - 75.0%) receiving a third chance.

The percentage of students who preferred a T. V. screen rather than a teletype for presenting the questions was not high (35.7%). The group, on the whole, did not find the teletype too noisy, and the fact that 78.5% of the pupils saved their printout sheets would indicate that the teletype is of more benefit than a T. V. screen setup would be.

The responses of one student to the questionnaire were quite unusual. She did not wish to continue with the program, found the problems too easy, did not have to concentrate at the teletype, and did not think she learned faster on the computer. Upon further investigation, it was discovered that this girl had scored highly on both the pre- and the post-tests, and had been the first student to finish all 24 problem types. It was obvious that the material covered in the computer program was not sufficiently challenging to hold her interest.

#### COMMENTS BY THE TEACHER

Barry Macdonald, who worked closely with the Department of Planning and Evaluation on many aspects of the project, made several comments in regard to the study.

In general, he was disappointed that the improvements in computational skills made by the Computer Group were not more marked. He granted that some of the gains evident might have been attributable to the enthusiasm and increased motivation generated by the novelty of the computer setup (the "novelty effect"), but, on the other hand, he thought that the gains would have been more impressive had the problems been more difficult and challenging for the sixth and seventh graders.

Mr. Macdonald cautioned that the computer program in arithmetic he had helped to write had only been tested in the one study, and that ideally programs should be "evaluated, revised and re-evaluated" until perfected. He felt that using a purchased program, which has been tested and perfected by the manufacturer, would be of more value.

Mr. Macdonald remarked that he had developed an interest in programmed learning techniques as a result of the CAI project, and had incorporated similar methods into his regular teaching. The project had impressed upon him the importance of "defining objectives clearly to the students and informing them previously how to meet those objectives". In addition, he had discovered the value of testing as a learning device, rather than a mere evaluation device.

Mr. Macdonald felt that the computer was best used as a teacher's tool to aid in the arithmetic program, and suggested that the work done on the computer be closely integrated with regular classroom study.

## DISCUSSION

While the results of the study suggested that:

- (a) computer-assisted instruction in addition to regular classroom instruction improves arithmetic skills, and that
- (b) computer-assisted instruction (five minutes per day per pupil) in addition to regular classroom instruction is superior to an additional five minutes of group instruction per day in improving arithmetic skills, none of the differences between the groups was statistically significant.

It was not determined how much of the improvement in performance of the Computer Group was attributable to the "novelty effect".

As the study progressed, it became apparent that the particular program being tested was not best suited to pupils in grades six and seven. The results of the pre- and the post-tests indicated that most of the pupils at these grade levels were quite proficient at basic arithmetic computations. Those with high scores (20 or more out of a possible 24) showed little or no improvement on the post-test, even when their regular instruction in arithmetic was coupled with additional drill on the computer. It was those pupils with low pre-test scores (14 and below) that seemed to benefit most from the use of the computer terminal. Of those pupils with low scores six of the seven were from grade six. Thus it

would seem logical to conclude that pupils at a lower grade level, who have not yet mastered the fundamentals of arithmetic, would benefit more from this particular application of CAI.

The involvement of lower grade levels (grades 4 and 5 for example) would have several advantages. The "level of motivation" factor, for instance, could be better controlled. In the present study, pupils had indicated their preferences for working or not working on the computer prior to being placed in a group; thus the Computer Group (containing all those who expressed a desire to work on the computer plus others with no preference) included several pupils who were highly motivated.

In addition, it was later learned that some of the pupils in grades six and seven were involved in a computer class being conducted at the school, and most of these pupils had chosen to work with the computer for the experiment. As a result, over 50% of the Computer Group had previous experience with the computer and/or wished to work on it. The fact that these students were familiar with computers in general may have offset the novelty effect, but this was not determinable. Using grade four and five pupils would simplify matters greatly by providing an unbiased experimental group: these pupils would not be involved in computer classes and could be placed randomly into the three groups to control for the motivation factor.

It was concluded that the study could be improved further through revision of the arithmetic tests used for pre- and post-testing. The fact that a few of the pupils had perfect scores on the pre-test, leaving no room for improvement under any treatment, indicated that a longer set of problems was required. With such a revised test, any improvement in speed and accuracy of computation by more advanced students could be more readily detected.

#### COMPUTER-ASSISTED INSTRUCTION: A SECOND STUDY

A second study is now in progress. Grade four and five students are being instructed in arithmetic by computer, and the arithmetic test used for pre- and post-testing has been revised as suggested above. Although a study of longer duration would be preferable (ideally the entire school year) time constraints will limit the study to six weeks. Several procedural modifications have been made as a result of the suggestions by students and teachers.

Pupils now are given a second chance to get a correct answer for a problem. When an error is made, the pupil is told, "YOU GOOFED. TRY AGAIN". The computer then reprints the question. The second try, however, is not counted as one of the thirteen possible questions, regardless of the pupil's success.

For the second study, the number of questions attempted, in addition to the number of questions answered correctly by the student, is printed to aid the teacher in evaluating the student's progress.

The order of problem types has been revised; problems are now in order of increasing difficulty. (For the grade six and seven study, the problems were grouped mainly according to sign--addition, subtraction, multiplication and division). Appendix F shows the new order of problem types.

Many of the pupils complained that the computer "took too long" during some phases of its operation. The following modifications have been implemented to reduce the time:

- 1) Elimination of the long title at the beginning of the program;
- 2) Elimination of the need for each student to set the randomizer (it is now set only once, at the beginning of the day);
- 3) Elimination of the fifteen-second delay between the termination of one pupil's session and the beginning of the next;
- 4) Adjustment of the spacing of the typewriter so that the line of print is not obscured by a typewriter bar. (The pupils often lost time by having to turn the roller of the typewriter to read the print);
- 5) Elimination of the redundant line, "The following problems are of the kind called. . ." (see Appendix E). However, the type number is printed when a pupil moves on to the next set or repeats the set he is working on.

It is anticipated that with a more appropriate experimental group and with the modifications cited above, the second study will illustrate more clearly the benefits of computer-assisted instruction. This study is now well under way, and it is expected that a report of its findings will be available by the end of June, 1973.

Name	Age	Grade	Date
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SOUTH HILL ARITHMETIC TEST -- FORM 1

$7 + 6 =$

$9 \times 6 =$

$15 - 3 =$

$8 \div 4 =$

Subtract

93.

62

Multiply

27

4

$72 \div 9 =$

$8 + 9 + 1 + 5 =$

$47 - 38 =$

$4 \overline{) 308}$

Add

55

83

Multiply

726

8

Add

543

820

957

$5 \overline{) 1766}$

Multiply

35

17

Subtract

845

61

Multiply

541

63

Add

1306

4925

Subtract

726

305

$16 \overline{) 400}$

$108 \overline{) 3510}$

Subtract

8907

6149

Add

3241

6182

1073

Multiply

804

329

Name	Age	Grade	Date
------	-----	-------	------

SOUTH HILL ARITHMETIC TEST -- FORM 2

$18 - 5 =$

$9 \div 3 =$

$6 + 7 =$

$6 \times 9 =$

$72 \div 8 =$

$5 + 1 + 9 + 8 =$

Subtract  
 $\begin{array}{r} 82 \\ - 51 \\ \hline \end{array}$

Multiply  
 $\begin{array}{r} 24 \\ \times 7 \\ \hline \end{array}$

Add  
 $\begin{array}{r} 83 \\ + 55 \\ \hline \end{array}$

Multiply  
 $\begin{array}{r} 728 \\ \times 6 \\ \hline \end{array}$

$57 - 48 =$

$4 \overline{)344}$

Multiply  
 $\begin{array}{r} 37 \\ \times 15 \\ \hline \end{array}$

Subtract  
 $\begin{array}{r} 654 \\ - 81 \\ \hline \end{array}$

Add  
 $\begin{array}{r} 957 \\ + 820 \\ + 543 \\ \hline \end{array}$

$6 \overline{)7155}$

Subtract  
 $\begin{array}{r} 762 \\ - 350 \\ \hline \end{array}$

$14 \overline{)609}$

Multiply  
 $\begin{array}{r} 514 \\ \times 36 \\ \hline \end{array}$

Add  
 $\begin{array}{r} 4925 \\ + 1306 \\ \hline \end{array}$

Add  
 $\begin{array}{r} 1073 \\ + 6182 \\ + 3241 \\ \hline \end{array}$

Multiply  
 $\begin{array}{r} 904 \\ \times 238 \\ \hline \end{array}$

$105 \overline{)3801}$

Subtract  
 $\begin{array}{r} 8407 \\ - 6199 \\ \hline \end{array}$

Name \_\_\_\_\_

STUDENT QUESTIONNAIRE ON CAI PROGRAM

Instructions: Read each question and decide which answer you agree with.  
Mark your answer on the computer card under the number of  
each question.

1. I WOULD LIKE TO CONTINUE WITH THE PROGRAM AFTER EASTER.

A. Yes      B. No      C. Sometimes      D. No opinion

2. THE TELETYPE IS TOO NOISY.

A. Yes      B. No      C. Sometimes      D. No opinion

3. THE TITLE TAKES TOO LONG TO TYPE.

A. Yes      B. No      C. Sometimes      D. No opinion

4. THE COMPUTER SHOULD NOT GIVE THE ANSWER THE FIRST TIME YOU  
GET IT WRONG--IT SHOULD GIVE YOU A SECOND CHANCE TO GET THE  
CORRECT ANSWER.

A. Yes      B. No      C. Sometimes      D. No opinion

5. THE COMPUTER SHOULD NOT GIVE THE ANSWER AFTER THE FIRST  
TIME OR THE SECOND TIME YOU GET IT WRONG--IT SHOULD GIVE YOU  
A THIRD CHANCE.

A. Yes      B. No      C. Sometimes      D. No opinion

6. I WOULD PREFER TO HAVE THE QUESTIONS ON A T.V. SCREEN.

A. Yes      B. No      C. Sometimes      D. No opinion

7. THE PROBLEMS ARE TOO HARD.

A. Yes      B. No      C. Sometimes      D. No opinion

8. I LIKE THE DATE ON MY PAPER.

A. Yes      B. No      C. Sometimes      D. No opinion

9. I LIKE THE TITLE.

A. Yes      B. No      C. Sometimes      D. No opinion



10. THE PROBLEMS ARE TOO EASY.

A. Yes      B. No      C. Sometimes      D. No opinion

11. I SAVE MY PRINTOUT SHEET.

A. Yes      B. No      C. Sometimes      D. No opinion

12. THE TELETYPE TAKES TOO LONG TO TYPE SOME QUESTIONS.

A. Yes      B. No      C. Sometimes      D. No opinion

13. THE TELETYPE WAITS TOO LONG BETWEEN STUDENTS.

A. Yes      B. No      C. Sometimes      D. No opinion

14. FIVE MINUTES IS NOT ENOUGH TIME.

A. Yes      B. No      C. Sometimes      D. No opinion

15. I GET WRONG ANSWERS TO MANY OF THE PROBLEMS.

A. Yes      B. No      C. Sometimes      D. No opinion

16. I LIKE HAVING MONIKA THERE TO HELP.

A. Yes      B. No      C. Sometimes      D. No opinion

17. I HAVE TO CONCENTRATE WHEN AT THE TELETYPE.

A. Yes      B. No      C. Sometimes      D. No opinion

18. I WISH THE COMPUTER SAID "YOU GOOFED" INSTEAD OF "WRONG".

A. Yes      B. No      C. Sometimes      D. No opinion

19. AFTER I TYPE IN THE PROBLEM TYPE, I LIKE THE COMPUTER REPEATING THE PROBLEM TYPE I ASKED FOR.

A. Yes      B. No      C. Sometimes      D. No opinion

20. I CAN DO ARITHMETIC FASTER NOW.

A. Yes      B. No      C. Sometimes      D. No opinion

21. I DO NOT LIKE WORKING WITH THE COMPUTER.

A. Yes      B. No      C. Sometimes      D. No opinion

22. IT IS HARD TO READ THE QUESTIONS.

A. Yes      B. No      C. Sometimes      D. No opinion

23. IT IS BORING.

A. Yes      B. No      C. Sometimes      D. No opinion

24. I LEARN FASTER ON THE COMPUTER.

A. Yes      B. No      C. Sometimes      D. No opinion

25. I DON'T LIKE MY LEVEL BEING SHOWN ON THE BIG CHART.

A. Yes      B. No      C. Sometimes      D. No opinion

26. I WOULD LIKE TO HAVE THE COMPUTER ADDRESS ME BY NAME.

A. Yes      B. No      C. Sometimes      D. No opinion

27. COMPUTERS MAKE MISTAKES.

A. Yes      B. No      C. Sometimes      D. No opinion

28. I FIND WORKING ON THE COMPUTER INTERESTING.

A. Yes      B. No      C. Sometimes      D. No opinion

## CAI PROGRAM--PROBLEM TYPES

1.  $2 + 3 =$	2.  $3 + 2 + 4 =$	3.  $4 + 7 + 6 + 1 =$	4.  $\begin{array}{r} 12 \\ + 34 \\ \hline \end{array}$
5.  $\begin{array}{r} 12 \\ 26 \\ + 31 \\ \hline \end{array}$	6.  $\begin{array}{r} 124 \\ + 315 \\ \hline \end{array}$	7.  $\begin{array}{r} 1279 \\ + 5684 \\ \hline \end{array}$	8.  $2 - 1 =$
9.  $\begin{array}{r} 23 \\ - 12 \\ \hline \end{array}$	10.  $\begin{array}{r} 232 \\ - 176 \\ \hline \end{array}$	11.  $2 \times 3 =$	12.  $\begin{array}{r} 23 \\ \times 2 \\ \hline \end{array}$
13. -  $\begin{array}{r} 247 \\ \times 3 \\ \hline \end{array}$	14.  $\begin{array}{r} 2316 \\ \times 4 \\ \hline \end{array}$	15.  $4/2$	16.  $20/2$
17.  $204/2$	18.  $\begin{array}{r} 124 \\ 371 \\ 262 \\ + 498 \\ \hline \end{array}$	19.  $\begin{array}{r} 1243 \\ 7962 \\ 4681 \\ + 3245 \\ \hline \end{array}$	20.  $\begin{array}{r} 2301 \\ - 1476 \\ \hline \end{array}$
21.  $\begin{array}{r} 24 \\ \times 13 \\ \hline \end{array}$	22.  $\begin{array}{r} 249 \\ \times 21 \\ \hline \end{array}$	23.  $\begin{array}{r} 2624 \\ \times 4132 \\ \hline \end{array}$	24.  $2042/2$

RUN

\*\*\*\*\*

SOUTH HILL COMPUTER-TUTOR  
ARITHMETIC DRILL

\*\*\*\*\*

TYPE ANY NUMBER FROM 1 TO 100?23

TYPE A NUMBER FROM 1 TO 25 FOR THE KIND OF PROBLEMS YOU WANT.?23  
THE FOLLOWING PROBLEMS ARE OF THE KIND CALLED 23 \*\*\*\*\*

APR. 6/73-SH MATH PROBLEMS

1                      249 / 3        = 789  
WRONG. CORRECT ANSWER IS 83

2                      768 / 4        = 767  
WRONG. CORRECT ANSWER IS 192

3                      680 / 5        = ?156  
WRONG. CORRECT ANSWER IS 136

4                      651 / 3        = ?217  
CORRECT

5                      845 / 6        = ?141  
CORRECT

6                      856 / 4        = ?214  
CORRECT

7                      756 / 9        = 784  
CORRECT

8                      700 / 5        = ?140  
CORRECT

9                      242 / 2        = ?212  
WRONG. CORRECT ANSWER IS 121

10                     420 / 3        = ?140  
CORRECT

11                     600 / 2        = ?300  
CORRECT

12                     894 / 3        = ?298  
CORRECT

13                     532 / 7        = ?76  
CORRECT

NUMBER OF QUESTIONS CORRECT 13 9 \*\*\*\*\*

ERIC YOU HAVE TIME FOR MORE QUESTIONS, THEN TYPE 1.  
YOUR TIME IS UP, TYPE 2, TEAR OFF SHEET, LET NEXT STUDENT START.

CAI PROGRAM--PROBLEM TYPES (REVISED)

1  $2 + 3 =$	2  $3 + 2 + 4 =$	3  $2 - 1 =$	4  $4 + 7 + 6 + 1 =$
5  $\begin{array}{r} 23 \\ - 12 \\ \hline \end{array}$	6  $\begin{array}{r} 12 \\ + 34 \\ \hline \end{array}$	7  $4/2$	8  $20/2$
9  $2 \times 3 =$	10  $\begin{array}{r} 23 \\ \times \quad 2 \\ \hline \end{array}$	11  $\begin{array}{r} 232 \\ - 176 \\ \hline \end{array}$	12  $\begin{array}{r} 12 \\ 26 \\ + 31 \\ \hline \end{array}$
13  $\begin{array}{r} 124 \\ + 315 \\ \hline \end{array}$	14  $\begin{array}{r} 124 \\ 371 \\ + 262 \\ \hline \end{array}$	15  $\begin{array}{r} 1279 \\ + 5684 \\ \hline \end{array}$	16  $\begin{array}{r} 1243 \\ 7962 \\ + 4681 \\ \hline \end{array}$
17  $\begin{array}{r} 24 \\ \times 13 \\ \hline \end{array}$	18  $\begin{array}{r} 247 \\ \times \quad 3 \\ \hline \end{array}$	19  $\begin{array}{r} 2316 \\ \times \quad 4 \\ \hline \end{array}$	20  $\begin{array}{r} 249 \\ \times 21 \\ \hline \end{array}$
21  $204/2$	22  $2042/2$	23  $\begin{array}{r} 2301 \\ - 1476 \\ \hline \end{array}$	24  $\begin{array}{r} 262 \\ \times 413 \\ \hline \end{array}$

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